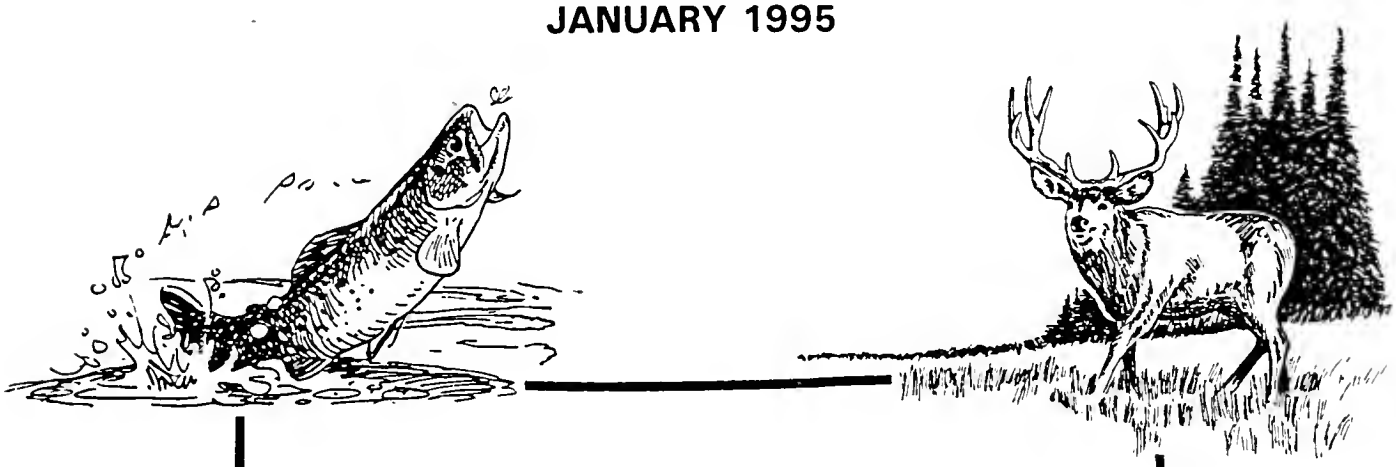
STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

CONTINGENT VALUATION OF NATURAL RESOURCES DUE TO INJURIES TO THE UPPER CLARK FORK RIVER BASIN

JANUARY 1995



CONTINGENT VALUATION OF NATURAL RESOURCE DAMAGES DUE TO INJURIES TO THE UPPER CLARK FORK RIVER BASIN

CONTINGENT VALUATION OF NATURAL RESOURCE DAMAGES DUE TO INJURIES TO THE UPPER CLARK FORK RIVER BASIN

STATE OF MONTANA
NATURAL RESOURCE DAMAGE LITIGATION PROGRAM

Prepared by:

RCG/Hagler Bailly
P.O. Drawer O
Boulder, CO 80306-1906
(303) 449-5515

Primary Authors:

William D. Schulze
Robert D. Rowe

Contributing Authors:

William S. Breffle
Rebecca R. Boyce
Gary H. McClelland

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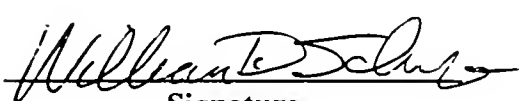
Testifying Experts:

William D. Schulze



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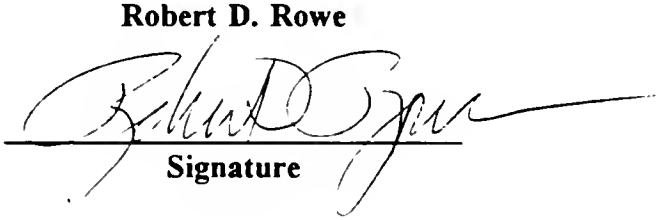
Robert D. Rowe



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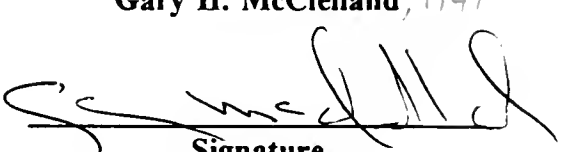
Gary H. McClelland, 1947-



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JANUARY 1995

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ACRONYMS

ADJWTP	Adjusted Willingness to Pay
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CV	Contingent Valuation
CVM	Contingent Valuation Method
Montana DHES	Montana Department of Health and Environmental Sciences
Montana NRDP	Montana Natural Resource Damage Program
NOAA	National Oceanic and Atmospheric Administration
NOBS	Number of Observations
NPL	National Priorities List
NRDA	Natural Resource Damage Assessment
OMB	Office of Management and Budget
U.S. DOI	United States Department of the Interior
U.S. EPA	United States Environmental Protection Agency
WTA	Willingness to Accept
WTP	Willingness to Pay

1.0 INTRODUCTION

1.1 OVERVIEW

The Clark Fork Basin drains an area of over 22,000 square miles, including nearly all of Montana west of the Continental Divide and a small part of northern Idaho. The Clark Fork River and its principal tributaries flow north and west from its headwaters above Butte, Montana, for about 340 river miles through a variety of terrain, including broad, semi-arid valleys, high mountain ranges, and deep valleys.

The Clark Fork Basin currently contains four National Priorities List (NPL) sites, also called "Superfund" sites, with numerous operable units (Figure 1-1). These sites are the Silver Bow Creek/Butte Area site, the Montana Pole site, the Anaconda Smelter site, and the Milltown Reservoir/Clark Fork River site. Since the late 1800s, mining and mineral processing activities at these sites have resulted in hazardous-substance contamination that has injured aquatic resources and riparian habitat along approximately 140 miles of Silver Bow Creek and the Clark Fork River from Butte to Milltown Dam, groundwater at several sites in the basin, and upland soils, vegetation, wildlife, and wildlife habitat at several locations throughout the basin.[1]

This report computes values held by the citizens of Montana for the following cleanup options at the Clark Fork NPL sites:

- *Complete cleanup* of the sites, or restoration of natural resources and their service flows to *baseline* conditions (i.e., conditions that would exist in the absence of releases of hazardous substances)

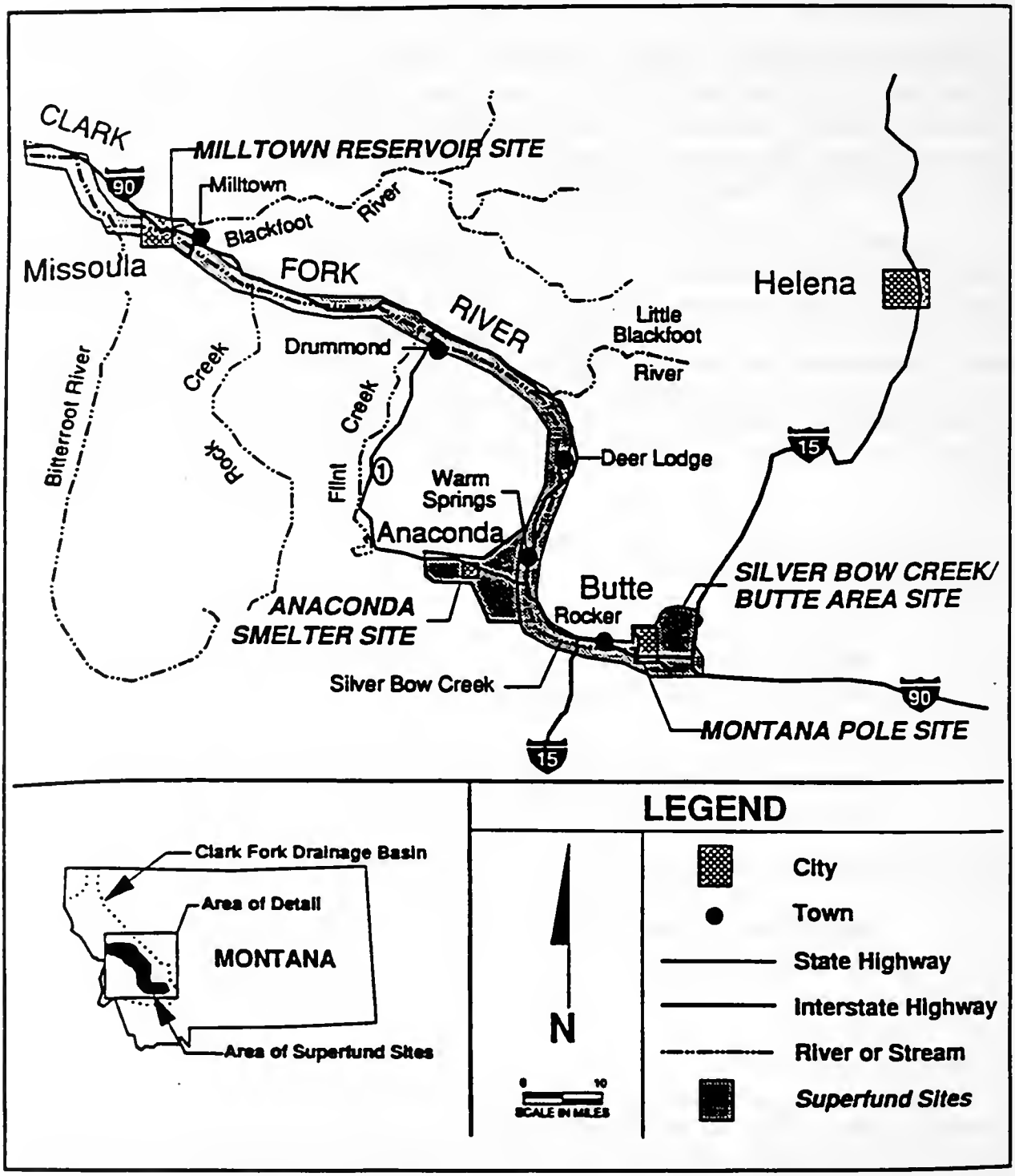
- *Partial cleanup* of the sites in a manner consistent with or exceeding remedial actions the U.S. Environmental Protection Agency (U.S. EPA) will likely require under the Superfund program, which will not achieve *complete cleanup*.

Also reported is the value for the difference between these options:

- *Residual value* is the difference in values for obtaining *complete cleanup* rather than *partial cleanup*.

[1] For more details on the history of the site and natural resource injuries, see the *Clark Fork Superfund Sites: Master Plan* (U.S. EPA and Montana DHES, 1992), the *Preassessment Screen: Clark Fork Basin NPL Sites, Montana* (Montana DHES, 1991), and summary natural resource injury assessment reports for the sites (Essig and Moore, 1992; Metesh, 1993; Montana NRDP, 1993; Lipton et al., 1995a; Lipton et al., 1995b; Maest and Metesh, 1995; Woessner, 1995a; Woessner, 1995b; and Woessner, 1995c).

Figure 1-1
Location of Superfund Sites in the Clark Fork River Basin



Source: U.S. EPA and Montana DHES, 1992.

Values for cleanup at the sites equal damages that will be experienced if these cleanup activities are not undertaken. The reported value measures are for cleanup activities that take many years to complete. As a result, these value measures for complete or partial cleanup do not include values for interim damages that will occur during cleanup activities.

The estimation of damages is conducted using the Contingent Valuation Method (CVM) implemented with residents of Montana. Damages to individuals who do not reside in Montana do occur (see, for example, Morey et al., 1995, for an estimate of recreation use value damages to nonresidents), but they are not estimated here to focus project resources on obtaining the best estimate of damages to Montana residents. This omission of damages for nonresidents results in a downward bias in the damage estimates.

The remainder of this chapter provides background on concepts and issues surrounding the valuation of natural resource injuries and introduces the CVM and selected CVM application issues that are addressed in this study. General CV issues, the survey design, and pretesting are discussed in Chapter 2.0. The survey implementation, response rates, and respondent characteristics are reported in Chapter 3.0. The results of attitude and opinion questions in the survey are reported in Chapter 4.0. The *willingness-to-pay* (WTP) valuation analysis and results are reported in Chapter 5.0. Statewide aggregate damage estimates and conclusions of the study are reported in Chapter 6.0.

1.2 VALUE CONCEPTS AND MEASURES

The economic components of this analysis focus on the damages to individuals from natural resource injuries caused by releases of hazardous substances in the Clark Fork Basin. Several concepts and terms are important in this analysis and are discussed further by the U.S. Department of the Interior (U.S. DOI) in its natural resource damage assessment regulations (56 *Fed. Reg.* at 19759-60):[2]

- *Use Values.* These refer to the values of one's own activities that are directly affected by natural resource injuries. Examples of use values include public recreation or commercial use of natural resources in the Clark Fork Basin.

- *Nonuse Values or Passive Use Values.* These refer to values individuals hold to protect or enhance resources not related to the individual's own direct use. Nonuse values include indirect use, bequest values, which ensure the availability of resources for use by others now and in the future, and existence

[2] Some authors use different terms to refer to these concepts, or define the terms slightly differently. These differences have no substantive impact on the analysis and interpretations presented in this report, because the report primarily focuses on compensable value. See Freeman (1979).

values, which protect the existence of resources in the Clark Fork River Basin even if the resources are never used.

- *Compensable Value.* This is the sum of all use and nonuse (passive use) value components. Although use and nonuse values separately provide information about the motives for valuing cleanup, compensable value is what is required for a natural resource damage assessment, and it is what is estimated in this report.

Recreational fishing damages (Morey et al., 1995) and other use value damages have occurred as a result of the releases of hazardous substances in the Clark Fork River Basin. Nonuse value damages can also be expected because without extensive restoration efforts the natural resource injuries are irreversible for decades or even centuries or millennia. Moreover, the injured area of the Clark Fork Basin, extending from Butte to Missoula, Montana, is an important site that has few substitutes in the region because of its location (adjacent to two cities and easily accessible to residents of a third city, Helena), its ease of access along an interstate highway, its prominent role in Montana's history, and its length — stretching approximately 140 miles.

The conceptual monetary measure of the change in an individual's well-being (or value) from a change in environmental quality can be thought of as the change in income that yields the same change in the individual's well-being as the change in environmental quality (for additional discussion see Freeman, 1979; Just et al., 1982; Morey, 1984; and Vartia, 1983). In most cases, value is measured by WTP. Just as value for a good like a shirt is measured by WTP, so can the value of changes in environmental quality be measured by WTP. Alternatively, *willingness to accept* (WTA) can be employed. WTA is the amount one would accept to forgo an environmental improvement or to allow environmental degradation. WTA may be appropriate if the affected individuals have a right to be compensated by the polluters. Where WTA measures are appropriate, they can be expected to exceed WTP measures. However, the theoretical difference is uncertain and may range from very small under specific assumptions (Randall and Stoll, 1980) to very large. Operationally, WTA responses are often much larger than WTP responses in CV studies and are plagued by those who do not respond or who respond with infinity, potentially reflecting emotional or ethical rejection of the WTA premise (Mitchell and Carson, 1989). Due to these concerns, DOI has mandated the use of WTP, and, therefore, this study obtains WTP value measures.

1.3 RELIABILITY OF THE CONTINGENT VALUATION METHOD

CVM is an Accepted Method

The CVM refers to a survey approach in which respondents are given information on a real or hypothetical situation and are asked through a structured procedure to reveal what their

behavior would be. Generally, as a way of measuring values for changes in environmental quality, this behavior is in terms of WTP through a simulated market for changes in natural resource quality. Detailed reviews of the implementation and issues with the method are found in Cummings et al. (1986) and Mitchell and Carson (1989).

The CVM is a well-established method for measuring values for changes in resource quality (Water Resource Council, 1983). In part, acceptance of the method to measure use value damages has been based on a series of studies in which value estimates obtained by asking respondents for their WTP were compared to values obtained from indirect approaches such as the hedonic price method and the travel-cost method (see, for example, Brookshire et al., 1982 and Smith et al., 1986). In several field experiments, actual purchase decisions were compared to hypothetical purchase decisions (Bishop and Heberlein, 1978 and Dickie et al., 1987). In all of these studies, hypothetical behavior was sufficiently predictive of actual behavior that researchers concluded meaningful values could be obtained for benefit-cost analysis or damage assessment.

The CVM, as a result of its role in calculating damages under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), has undergone Federal Court review (U.S. Court of Appeals, District of Columbia Circuit, 1989). The court rejected a challenge to DOI's use of contingent valuation in calculating both use and nonuse value damages recoverable by trustees for valuing resources harmed by oil spills and hazardous substances, and recognized this method as a "best available procedure." The court denied the challenge, stating, "We find DOI's promulgation of CV methodology reasonable and consistent with Congressional intent, and therefore worthy of deference....We find no cause to overturn U.S. DOI's considered judgment that CV methodology, when properly applied, can be structured so as to eliminate undue upward biases."

In addition, the same Federal Court ruled that nonuse values "ought to be included" in damage assessments. CVM is the only method presently accepted by DOI and the Federal Court to measure nonuse values.

Factors to Evaluate the Reliability of Nonuse Value CVM Studies

To address issues on the reliability and the use of CVM nonuse value estimates in natural resource damage assessments, the National Oceanic and Atmospheric Administration (NOAA) commissioned a "Blue Ribbon Panel on Contingent Valuation" (58 *Fed. Reg.* 4601, Jan. 15, 1993). The panel concluded that contingent valuation can provide reliable measures of nonuse values. The panel identified a list of CVM design, implementation, and analysis factors it felt would ensure reliability of CVM studies.

Subsequent to the NOAA panel, NOAA issued proposed CVM regulations (59 *Fed. Reg.* 1062, Jan. 7, 1994) and DOI issued CVM proposals for comment (59 *Fed. Reg.* 23098, May 4, 1994). The NOAA and DOI regulatory proposals are subject to continued revision in

response to public comments. For example, the U.S. Environmental Protection Agency (U.S. EPA, 1994) commented that there are many excessive and inappropriate requirements and recommendations in the NOAA and DOI regulatory proposals.

The list of factors identified by the NOAA panel for a reliable CVM study were, with modifications, deletions, and additions, reflected in the subsequent NOAA and DOI regulatory proposals. Table 1-1 includes a summary listing of the principal factors identified by all of these three proposals. The relative importance of the individual factors for obtaining a reliable CVM study was not addressed by the NOAA panel or by the subsequent proposed regulations and is still being addressed in the regulatory process.

Table 1-1
Summary of CVM Design, Implementation, Analysis, and Evaluation Factors*

Design and Implementation Factors	
1.	Use of probability sampling.
2.	Minimization of nonresponse.
3.	Use of face-to-face interviews preferred to telephone and mail surveys.
4.	Careful pretesting of the questionnaire.
5.	Conservative design.
6.	Use of WTP as opposed to WTA measures of value.
7.	Preference for a referendum format for eliciting values.
8.	Accurate description of the program or policy.
9.	Photographs should be pretested.
10.	Reminders of substitute commodities included.
11.	A "no answer" option for valuation questions included.
12.	Follow-up questions to valuation questions provided.
13.	Checks of understanding and perceptions of the survey by respondents.
14.	Respondents reminded of alternative expenditure possibilities.
15.	Values derived from a *warm glow* of giving or dislike of "big business" deflected.
16.	Timing of remediation made clear to respondents.
17.	Consideration to lump-sum payments.
Analysis and Evaluation Factors	
18.	Calibration of CVM results.
19.	WTP shows responsiveness to scope of injuries.
20.	Respondents do not show a lack of task understanding.
21.	Respondents indicate restoration scenario is believable.
*	Sources: NOAA Blue Ribbon Panel on CVM (58 *Fed. Reg.* 4601 Jan. 15, 1993); NOAA Proposed CVM regulations (59 *Fed. Reg.* 1062, Jan. 7, 1994), DOI Proposed CVM regulations issued for comment (59 *Fed. Reg.* 23098, May 4, 1994).

The factors in Table 1-1 provide one basis of evaluation for CVM studies. For a CVM study based on the factors listed by the NOAA panel, the NOAA panel stated: "We think it is fair to describe such information *[the results of a CVM study]* as reliable by the standards that seem to be implicit in similar contexts, like market analysis for new and innovative products and the assessment of other damages normally allowed in court proceedings. As in all such cases, the more closely the guidelines are followed, the more reliable the result will be. It is not necessary, however, that every single injunction be completely obeyed; inferences accepted in other contexts are not perfect either" (p. 4610, phrase in italics added for clarity).

1.4 THE CLARK FORK CVM STUDY IS RELIABLE

Summary

The Clark Fork CVM study was designed and in-field implementation began before the NOAA panel and subsequent proposed rules were issued. Nonetheless, the study design and implementation are consistent with 13 of the 17 design and implementation factors suggested in the various NOAA and DOI proposals. This study substantively differs from the Table 1-1 design and implementation factors only for factors 3 (in-person interviews), 7 (referendum format for value elicitation), 11 (a "no answer" option for valuation), and 17 (lump-sum payment). For these four factors, the study design and results meet the underlying objectives in order to have a reliable CVM study. The design and implementation features of this study are summarized below.

The study also is consistent with all of the analysis and evaluation factors. Respondents demonstrate an understanding of the task and find the cleanup scenarios credible (see Sections 4.0 and 5.2), respondents demonstrate responsiveness in their values to the scope of the injury (see Section 5.5), and the design and statistical analysis address embedding and potential value measurement error directly rather than using an artificial calibration factor (see Sections 2.1, 2.2.8, 5.2, and 5.3).

Based on these factors, and the underlying objectives in specifying these factors, this CVM study should be judged as reliable.

Consistency With Design and Implementation Factors

In this section we first summarize how the Clark Fork Study is consistent with 13 of the 17 design and implementation factors for a reliable CVM that are listed in Table 1-1. Next, we summarize how this CVM design and implementation is consistent with the objectives for obtaining reliable results that underlie factors 3, 7, 11, and 17. Each factor is identified by the factor number in Table 1-1, and by the location in this report where additional discussion is found.

The study uses a probability sample (Factor 1) of Montana residents that covers 83 percent of households, and the sample characteristics have a good correspondence to the population characteristics (Section 3.0). Differences in the survey and population characteristics are addressed and corrected in the analysis (Section 5.4). The survey minimizes nonresponse rates (Factor 2) by achieving a response rate of 68 percent to the mail survey, and of 75 percent including respondents to the telephone follow-up survey. Further, the survey has nearly a 100 percent response rate to all but two questions: the income question has a 92 percent response rate and the follow-up question addressing embedding has a 95 percent response rate (Section 3.2).

The survey instruments and photographs were carefully pretested through verbal protocols and pretests with over 200 participants (Factors 4 and 9, see Section 2.4). The study is accurate (Factor 8), yet conservative (Factor 5), in design and analysis. The study uses a neutral design that, overall, presents an accurate but understated level of injuries. The analysis is conservative in the treatment of the WTP responses, and omits nonresident values (Sections 2.0 and 5.0). Checks on respondent understanding and perceptions of the survey (Factor 13) were included in the pretesting process (Section 2.4) and in the survey design and analysis through attitude and opinion questions and consistency checks on respondent responses (Sections 2.0 through 5.0).

The scenarios use a WTP measure of value (Factor 6) and have follow-up questions (Factor 12) including open-ended comments directly after the WTP question and at the end of the survey, and questions specifically addressing the potential for embedding in WTP responses and respondent attitudes about their responsibility for paying for cleanup (Sections 2.2.8, 2.2.10, 5.2, and 5.4). Reminders of substitute commodities and alternative expenditure possibilities in the survey (Factors 10 and 14) include maps of Montana with the NPL sites shown, questions on cleaning up alternative NPL sites in Montana and alternative issues facing Montana residents, and questions on alternative cleanup options at the Clark Fork NPL sites. Responses to all of these questions complement the familiarity of Montana residents with Montana resources and issues (Section 2.0).

Potential warm glow values are specifically detected through follow-up questions (Factor 15, see Section 2.2.8 and 5.2). Dislike for "big business" is minimized through the survey design (Factor 15). If anti-business sentiment does impact the results, the effect is to reduce, or provide conservative, WTP values (Section 5.2). Finally, in pretesting, it was determined that Montana residents recognize that remediation will take years to decades to undertake. Therefore a ten-year horizon is specified for the payment period to correspond to a plausible remediation period (Factor 16).

Factor 3. The proposed CVM factors suggest that in-person interviews may in some cases be preferred to telephone or mail surveys for reasons related to the sampling frame, completion rates, and survey effectiveness. The study here employs a survey approach that uses both mail and telephone interview techniques and overcomes potential limitations associated with

all survey techniques. First, it has been suggested that in-person or telephone surveys may be preferred where the sample frame for mail surveys omits a large portion of the population. However, because 83 percent of households in Montana have listed telephone numbers, from which addresses were obtained for this study, this reason for preferring in-person or telephone surveys is not compelling in Montana.

Second, it has been suggested that response rates to the survey and individual questions will be higher through the use of in-person surveys rather than mail surveys. The procedures used for this survey produced a response rate to the survey of 68 percent, with all survey questions being completed by 63 percent of the sample (93 percent of those responding). Including the telephone follow-up efforts, 75 percent of the eligible sample participated in the study. This compares favorably with the expected response rates from the considerably more expensive in-person interview approach.[3] This response rate was obtained through a series of repeat contacts and a compensation of $20 for time and effort if the entire survey was completed. If respondents accidently failed to fill out any of the relevant questions for data analysis, they were contacted by telephone to obtain the missing responses.

The approach used here to compensate respondents, besides producing a high response rate for completed surveys, also addresses a major concern for all types of surveys: that only respondents who care about the issues will respond to a mail survey or, in the case of a face-to-face or telephone interview, complete the entire lengthy survey process. By compensating respondents adequately, all respondents have an interest in completing the survey, rather than just those with an interest in the subject matter.

Third, we are aware of no published literature with direct comparisons of the effectiveness of mail versus in-person interviews for CVM surveys that suggests the mail survey approach cannot be effective. One indirect comparison occurred recently when two different groups implemented CVM valuation surveys addressing total use plus nonuse values for visibility changes in the Grand Canyon: one using mail surveys (Chestnut and Rowe, 1990a), and one using in-person surveys (Decision Focus Inc., 1990). The results of this comparison are found in the U.S. EPA administrative record for the Navajo Generating Station Regulatory Impact Analysis. Although the survey implementation procedures and survey designs differed in many ways, the two studies obtained very similar mean WTP results for the most comparable annual average visibility change scenarios, and the differences in results are consistent with differences in the survey designs and the data analysis procedures (Chestnut and Rowe, 1990b).

[3] For example, the Exxon Valdez CVM study sponsored by the State of Alaska (Carson et al., 1992) obtained an approximate 61 percent fully complete response rate. Including non-English speaking potential respondents the Alaska study obtained a gross response rate of 73 percent after multiple contacts with target respondents, but more than 16 percent of these respondents did not report variables such as age and income.

The U.S. EPA, because of the considerable cost of in-person surveys and its extensive reliance on mail surveys, requested a specific evaluation of the NOAA panel recommendations from Dr. Donald Dillman, Professor of Sociology at Washington State University and Chief Scientist of the U.S. Census Bureau. His response is enclosed as Appendix D to this report and makes clear that there is no well-established uniform preference with respect to response rates, costs, or accuracy of results for in-person or telephone CVM surveys over mail surveys.

For this analysis, the mail survey technique was the most appropriate choice because of the high percentage of listed telephone numbers in Montana, the high response rate and high quality responses resulting from concern for the topic in Montana combined with the completion incentive, and because the implementation costs are 10 to 20 times higher for in-person surveys than for mail surveys. These factors meet the underlying goals for a reliable survey implementation, plus they lead to a cost effective survey effort.

Factor 7. In the referendum approach (also called dichotomous choice), respondents are given a specified resource change and WTP scenario and asked whether they would vote yes or no to pay a specified amount for the resource change. The use of a referendum approach is recommended by the NOAA panel and the subsequent NOAA and DOI proposed regulations, but the payment card approach used in this study is permitted. The U.S. EPA comments on the proposed regulations (U.S. EPA, 1994) explicitly note that the referendum approach should not be given preference as the approach is neither cost effective nor necessarily more accurate, and may result in larger values than other approaches such as use of a payment card.

The most common arguments in favor of the referendum format are that the question is easier for respondents and that policy makers would find the approach appealing because it is akin to a referendum vote. However, evidence suggests that the referendum approach may produce values larger than those obtained by alternative approaches (see, for example, Johnson et al., 1990; Jordan and Elnagheeb, 1994; Walsh et al., 1989; Kealy et al., 1988; Sellar et al., 1985; and Boyle and Bishop, 1988), requires greater sample sizes (and study costs) to achieve statistical efficiency comparable to other approaches (Cameron and James, 1987; Kanninen, 1993; and U.S. EPA, 1994), and must deal with other uncertainties in the design and statistical interpretation of referendum-approach data (Duffield and Patterson, 1991; Boyle and Bishop, 1988; Boyle, 1990; Cooper and Loomis, 1992; Cameron and Huppert, 1991; Kanninen and Kriström, 1993; and McConnell, 1990).

Given the difficulty that respondents may have in generating specific values when no values are provided in the survey (i.e., an open-ended fill-in-the-blank format), the payment card approach, in which respondents choose an appropriate value from a wide range of values, helps respondents in the exercise by listing a wide range of values from which to choose. The NOAA panel suggests, without reference, that payment cards are likely to be subject to range and centering biases. Based on recent research specifically addressing range and

centering biases this comment does not apply to the payment card design used in this study (Section 2.2.7). Therefore, the payment card approach used in this study is both conservative and reliable.

Factor 11. The omission of the "no answer" response to the WTP question is expected to have an insignificant impact on the reliability of the results and to potentially downwardly bias the results.

The NOAA panel initially recommended a "no answer" response to valuation questions, but the emphasis on this factor was significantly reduced in the subsequent NOAA and DOI proposals, and the significance of this factor has been questioned by the U.S. EPA in its comments on the proposed regulations. There is limited literature that provides quantitative information on the subject of providing a "no answer" response to valuation questions. Chestnut and Rowe (1990a) asked respondents to rate their self-perceived accuracy of their WTP response as "very accurate," "within the ballpark," "somewhat inaccurate," or "probably very inaccurate." These authors found that WTP decreased in statistically significant increments as the self-reported accuracy decreased. The authors concluded that (1) the less well understood the resource changes are for respondents, the more uncertain and inaccurate responses are likely to be, and values will decrease; (2) lowered values with lowered accuracy may reflect a tendency to provide a value less than the maximum WTP to reflect uncertainty about the valuation; and (3) forcing respondents to provide answers to questions about which they are uncertain may lead to downwardly biased WTP results. In the current study, through the use of a $20 participation incentive we encourage more careful attention to the questions, and high question response rates are obtained. As such, a "no answer" option was omitted in the WTP response categories provided to respondents (although in the mail survey, respondents could write in "don't know" or other responses).

Factor 17. While not identified in the NOAA panel report, the NOAA proposed rules suggest that the use of a lump-sum payment may be preferred to the use of annual payments. Justification for this preference is not documented in the proposed regulations; rather, the NOAA proposed rules simply state that the approach will lead to conservative (rather than accurate) value estimates. We concur with the U.S. EPA comments on the regulations (U.S. EPA, 1994) that a lump-sum payment should not generally be preferred. The approach used in this study of obtaining an annual WTP for ten years is more reliable than the use of a lump-sum payment approach would have been. The ten-year payment approach is more credible than a lump-sum payment as a strategy to collect funds for cleanup, is more credible in relationship to the cleanup efforts that will take many years to complete, and minimizes the impact of one-year income constraints on the ability to pay for cleanup of the Clark Fork sites. The ten-year payment period has a lump-sum feature in that it restricts the payment period as compared to annual payments in perpetuity. It can be expected to provide reliable results (Section 2.2.7).

2.0 SURVEY INSTRUMENT DESIGN AND PRETESTING

2.1 SURVEY DESIGN OVERVIEW

This CVM survey was designed to estimate the economic value to citizens of Montana of natural resource injuries resulting from the release of hazardous substances in the Clark Fork River Basin. Specifically, this includes values for:

- *Complete cleanup* of the sites, or restoration of natural resources and their service flows to *baseline* conditions (i.e., conditions that would exist in the absence of releases of hazardous substances)

- *Partial cleanup* of the sites in a manner consistent with or exceeding remedial actions the U.S. EPA will likely require under the Superfund program, which will not achieve *complete cleanup*.

Also reported is the value for the difference between these options:

- *Residual value* is the difference in values for obtaining *complete cleanup* rather than *partial cleanup*.

Two survey versions were implemented to examine selected CVM design issues. After introductory questions, Survey Version 1 first elicits a value for complete cleanup of hazardous substances in the Clark Fork River Basin and then elicits a value for partial cleanup. Version 2 reverses the order of the valuation questions and asks the respondent to provide a value for partial cleanup, and then to provide a value for complete cleanup. Except for the above identified design changes, the survey versions use the same questions. The design of Version 1 is discussed in Section 2.2. Next, the differences in Version 2 are discussed in Section 2.3. Finally, the process of developing these instruments through pretesting is summarized in Section 2.4. Copies of the final mail survey instruments for Montana residents are included in Appendix A.

Several issues have emerged related to the ability of the CVM to assess use and nonuse values accurately and are specifically addressed in this study. These are: (1) the presence of noncredible zero values resulting from *scenario rejection*; (2) the presence in the survey responses of a small number of questionable *large values*; (3) a concern that *embedding* of values occurs wherein respondents provide values for a larger set of goods than the survey requests; and (4) a concern that changes in *context* or wording of questions can have a large impact on values. We next discuss each of these issues and their implications for this study.

Selected CVM Issues

Scenario Rejection. An issue in the interpretation and analysis of CVM responses is the presence of protest zero responses or nonresponse to WTP questions attributable to scenario rejection. When pretesting survey instruments, researchers debriefing respondents have found that zero WTP responses, or failures to respond at all, are often not associated with true zero values for the respondent, but rather the respondent does not feel responsible for the problem or feels an alternative solution is appropriate. As a result, the respondent does not reveal his value for the change in natural resources, but rather reveals his protest of the CVM scenario. Similarly, scenario rejection can lead to positive reported WTP values that are less than true values. For example, a respondent may argue that she is not responsible for creating the problem, but is willing to participate by paying only a share of what the cleanup is worth to her (i.e., less than her maximum willingness to pay, or value, for cleanup). The result of partial or total scenario rejection is that the reported WTP values provide an understated (downwardly biased) reflection of the damages associated with natural resource injuries. The greater the scenario rejection, the greater the understatement of damages provided by the WTP results.

The mental process leading a respondent to reject the scenario in this study and to report a WTP less than his value for natural resource damages may be as follows: "Cleaning up the Clark Fork Basin would be very valuable to me, but contamination at these sites is not my fault so I should not have to pay. Industry or the federal government should pay. I will respond with a zero WTP, or provide a small WTP reflecting that I protest the scenario but that I'm willing to cooperate somewhat, or maybe I will not answer the question since it does not apply to me." Interestingly, such respondents, when asked for their willingness to accept a decrease in environmental quality, often refuse any amount of money, arguing that to do so would be morally wrong. Thus, moral reasoning results in an unwillingness of respondents to provide any tradeoff between money and the public good in question.

Partial identification of scenario rejection responses can be accomplished in at least three ways in the design of a survey instrument, all of which are employed in this study. First, a question asking the respondent to comment on the WTP response can be included, where respondents often reveal scenario rejection. Second, questions asking how concerned about, bothered by, or important the commodity is to the respondent can be used to check for consistency of a zero WTP response. Third, a question asking if the respondent feels responsible for cleaning up the problem can be asked and used to calibrate the scenario rejection in the WTP results.

Large WTP Responses. Survey values obtained for nonuse values tend to have a distribution that is skewed, showing a tail of large WTP responses. Researchers have viewed large WTP responses with concern because a few large WTP responses can have a disproportional impact on the average WTP value reported by the sample.

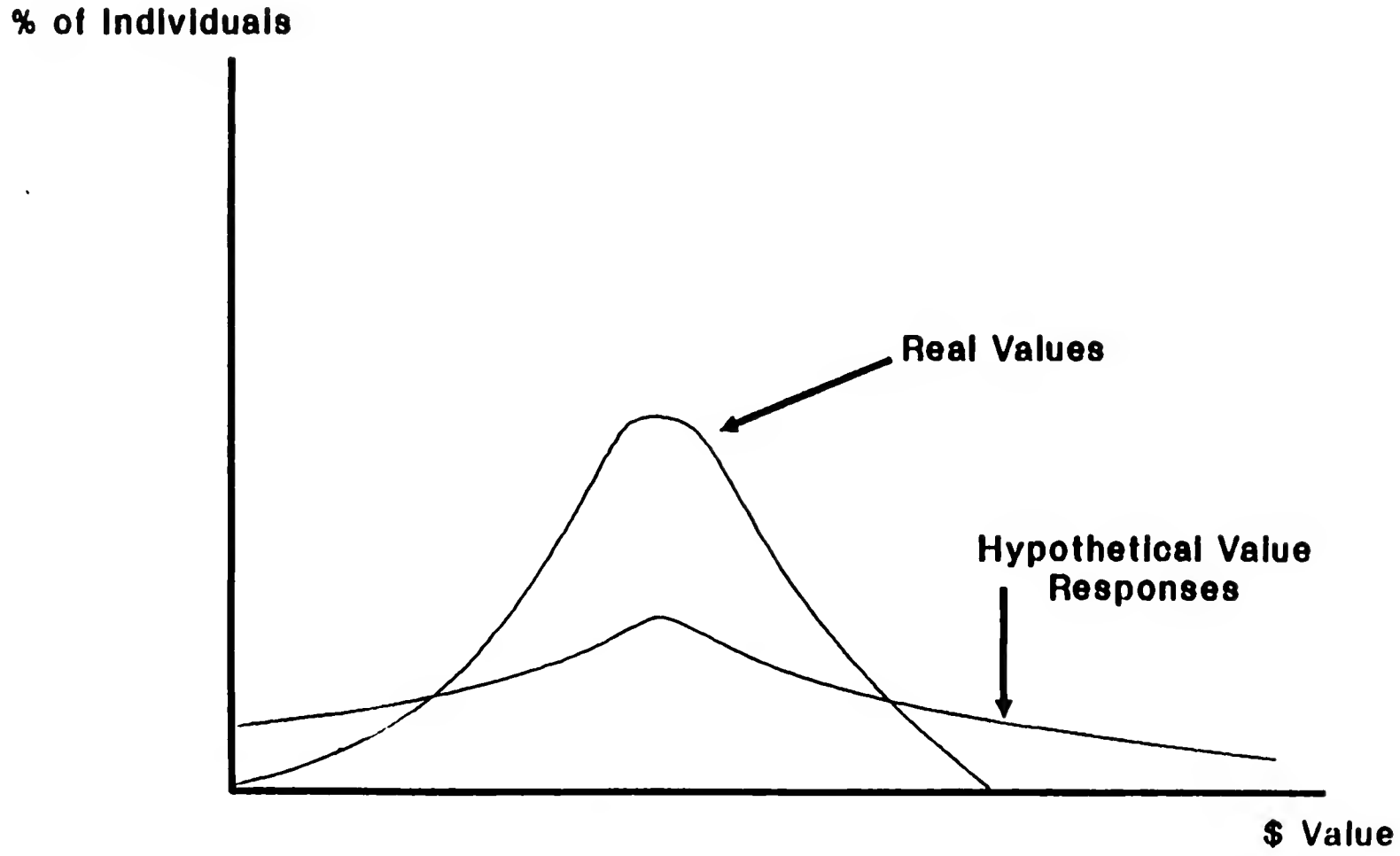
Figure 2-1 shows a highly skewed distribution of hypothetical WTP responses relative to the actual value distribution. Data from both field and laboratory research suggest that the extended right hand tail may be due in part to underlying preferences and in part to increasing (or skewed) measurement error. Using actual behavior data for recreation use of sites, Morey et al. (1993) find that population WTP values have a distribution that is highly skewed. However, if there is also skewed measurement error, the estimated mean WTP will result in an upwardly biased estimate of the true population mean value.

Several standard procedures have been used in this study to address this concern. Simple consistency checks can be used to eliminate suspiciously large WTP responses. For example, if a WTP response is inconsistent with other survey response information, that WTP response is removed from the data set so as to interpret responses conservatively. Similarly, suspect large WTP responses may be identified through econometric analysis where WTP is more formally related to income and other variables. Observations that deviate from the estimated regression line by some predetermined (by the researcher) threshold amount are deleted from the analysis (Desvousges et al., 1987).

A third approach used in Section 5.3 derives from evidence in laboratory economics experiments. These experiments typically place subjects in an unfamiliar environment (with respect to the commodity, the market, or both) and compare an initial hypothetical response to actual laboratory market responses where repeated trials are used with real money transactions to provide market experience. Results from these experiments show a consistent pattern. Hypothetical WTP values obtained from subjects for a commodity show an increased variance relative to values obtained in a laboratory simulation of an actual market. Further, both increasing market experience (repeated rounds in a particular auction institution) and increasing incentives (increased payoffs for participation in a particular market institution) tend to reduce variance in the WTP responses (see, for example, Irwin et al., 1989). One interpretation of the unexplained variance in WTP responses (not explained by variables such as income and proximity to the sites) is that this is the result of measurement error, which is addressed by the conservative lognormal error correction procedure discussed in Section 5.3.

Embedding (Part-Whole Bias). Another issue receiving attention is embedding values for multiple goods in response to the CVM question (see, for example, papers by Kahneman and Knetsch, 1991 and by Smith, 1991). Research suggests that some respondents may have a different view of the provision of public goods than that implicit in the way CVM questions are asked. One particular concern is that respondents may view an additional dollar of taxes as producing a variety of public goods as joint products. Stated another way, respondents may be valuing a larger or smaller commodity than the researcher intended (Mitchell and Carson, 1989). Fischoff and Furby (1988) suggest that "...respondents might be told to disregard how a change in air pollution affected their health risk. However, such selective forgetting may not always be possible. If it is natural to think of an intervention's impacts as a whole, there may be no way to segregate mentally its individual effects." (page 155).

Figure 2-1
Actual vs. Hypothetical Value Distribution



The information presented may also affect the valuation of injuries at an individual site with hazardous substances. For example, the cleanup of contamination at one site may be viewed as a part of cleaning up contamination at all hazardous waste sites. If respondents are able to use enhanced information to separate values for the restoration of the individual sites, then embedding (or part-whole bias) may be reduced.

The issue of embedding is one that encompasses psychology and economics. This problem has been long recognized by CVM researchers (see, for example, Cummings et al., 1986). Procedures have been developed (see, for example, McClelland et al., 1991 and Chestnut and Rowe, 1990a) that include the provision of information and follow-up questions to separate embedded values for components not of direct interest to the study. These procedures are used in this study (see Sections 2.2.8 and 5.2).

Context. Context refers to the design of the CVM valuation questions and includes considerations of the effects of the presentation of the hypothetical market and supporting information in the CVM survey. This includes how and to whom payments will be made, who will make payments, what payments will be used for, who is responsible for cleaning up contamination at hazardous waste sites, and so forth. For example, Fischoff and Furby (1988) assert, "In general, the more novel a transaction, the more its details will need to be explained and the more difficult it will be to ensure that those details are understood" (page 152). In part, this view is consistent with Schuman and Presser (1981), who have argued that the more crystallized the values and attitudes are, the less important minor context changes are likely to be in survey design.

Minor wording changes in a CVM survey in and of themselves may have little impact (Chestnut and Rowe, 1990a and McClelland et al., 1991), but the cumulative impact of providing a more complete context may improve the ability of respondents to form values. However, this improvement may come at the expense of survey length and potential response rates:

> Simply telling people everything provides no guarantee that they have understood everything. Such a strategy might even impede understanding if attention to critical features of the contingent market is diverted by a deluge of details about features that could have gone without saying because they have little practical effect on decisions (Fischoff and Furby, 1988).

Therefore, the researcher must balance the need for information against the ability of the respondents to absorb information. Relatively minor context features may have to be unstated for a CVM instrument to be manageable. The challenge for the researcher is to determine which information is critical in terms of the impact on WTP measures of interest. In this study, the instruments are designed to incorporate the fundamental characteristics required for a valid CVM. Our guiding principle in designing the context for the value elicitation is to keep it realistic and credible, but simple and straightforward. Survey variations then alter the

context and information presented to begin to address specifically the sensitivity of results to these concerns.

2.2 SURVEY VERSION 1

2.2.1 A Neutral Policy Perspective

The survey is designed to present neutrally the issues of cleanup of hazardous substances in the Clark Fork River Basin as a policy question of interest to government and industry officials. For example, the cover letter enclosed in the first mailing of the survey includes the following information:

> "Government and industry officials in Montana are evaluating what should be done about cleaning up hazardous waste sites in the state, particularly in the Clark Fork River Basin. It is important that they be informed about how people like you really feel about these issues."
>
> "Whether you believe cleaning up hazardous waste sites is worthwhile or not, your opinion matters. The survey does not require that you have any special knowledge; we just ask that you take the time to consider each question and respond with your opinions."
>
> "A summary of the results of this study will be made available to government and industry representatives."

Throughout the survey, the design reinforces the interest in the issue from a future policy perspective. This perspective also avoids any indication that the results relate to the assessment of damages in pending litigation.

A $20 incentive compensation was provided for the return of a fully completed survey. This incentive was provided to communicate the survey was a serious study requiring the respondent's full attention, and to stimulate high response rates.

In the pretest process, the respondents reported that they felt the survey was conducted to understand what citizens think should be done to clean up the Clark Fork River Basin. Further, they reported that they feel their responses matter, and they took the questions seriously.

2.2.2 Survey Cover

The front cover is titled "Cleaning Up Hazardous Wastes in Montana, The Clark Fork River Basin: What is Your Opinion?" to convey general concern with the issue. The project is identified as being conducted by RCG/Hagler Bailly. A Montana return address was given along with a toll-free number for respondents to call if they had any questions.

The front cover includes a map of the State of Montana and identifies the eight hazardous waste sites that have been designated as Superfund (National Priorities List) sites by the U.S. EPA and includes a magnified portion of the region in the Clark Fork River Basin that has been affected by hazardous substances. This map is later used as a reference in the survey text. While the survey title focuses on the Clark Fork sites, the identification of the eight NPL sites on the map makes it clear that the Clark Fork NPL sites are not the only such sites in Montana, a point that is reiterated throughout the survey. The purpose of identifying other sites is to recognize substitute sites for cleanup activities and to address and correct for any values for the cleanup of other sites that might be embedded in the reported values for the cleanup of the Clark Fork sites. The back cover allows space for the respondents to add comments, which the researchers can use to check for consistency of individual responses and to understand the responses better.

2.2.3 Survey Introduction

The first section of the survey (Q1 and Q2) focuses on general awareness and attitudes about hazardous waste sites in Montana. The introduction questions are straightforward, making it easy for the respondent to begin the survey (Dillman, 1978). Question 1 investigates familiarity with the eight Montana NPL sites.[1] Question 1 identifies that there are over 250 sites in Montana where hazardous substances may be present, and introduces and lists the eight NPL sites. This continues to emphasize that the Clark Fork NPL sites are not the only Montana sites contaminated by hazardous substances and that there are substitute sites for cleanup activities. Question 2 recognizes that cleanup of hazardous waste sites is only one issue facing local citizens and requires the respondent to consider the importance of cleaning up sites with hazardous substances relative to other issues facing residents. The intent is to diffuse any importance bias to a specific topic that may result by receiving a survey on a specific topic, to recognize substitute public issues that may deserve attention, and to obtain a general understanding of how important residents feel it is to clean up sites with hazardous substances. The issues identified were based on other survey results (Rowe et al., 1991) and pretest efforts.

[1] The eight sites are the Silver Bow Creek/Butte Area site, the Montana Pole site, the Anaconda Smelter site, the Milltown Reservoir/Clark Fork River site, the East Helena site, the Idaho Pole Company site, the Mouat Industries site, and the Libby Groundwater site. The first four are Clark Fork NPL sites.

Color Inserts. Inserts were enclosed with all surveys. The inserts contained black and white figures that show diagrammatically the processes of natural resource contamination, a color map of the Clark Fork River Basin and the Clark Fork River Superfund sites, and color photos depicting contaminated areas in the Superfund sites and similar areas that have not been contaminated for visual comparison. The final photographs were chosen after pretesting. The photos depict what the areas currently look like and what they would look like if hazardous substances had not been released. The photos do not show pristine environments, but rather, how the areas would look as affected by other human activity such as road construction and agriculture. The photographs were chosen to provide a conservative representation of injuries at the site (for example, not all injuries are shown). The inserts were printed on glossy paper for increased clarity and measure 11" by 17". A copy of the color photos is included in Appendix A.

2.2.4 Impacts and Cleanup of Hazardous Substances

In this section of the survey (Q3 through Q14), information is given about contamination of three groups of natural resources: (1) aquatic resources and riparian habitat; (2) groundwater; and (3) upland soil, vegetation, wildlife, and wildlife habitat. Also presented are three types of cleanup or replacement options to address natural resource contamination. This section serves as an introduction to the sources, causes, and characteristics of natural resource injuries due to contamination. It further serves to introduce the resource-group framework for addressing natural resource impacts, and provides discussion of the types of cleanup options that can be used to address contamination of these resource groups. This framework is used later in the willingness-to-pay questions to define the "good" (a change in natural resource quality obtained through cleanup activities) that will be valued.

Each of the three natural resource groups is addressed in turn. For each resource group, typical sources and types of contamination, along with natural resource impacts, are described. Respondents are asked to unfold the color insert enclosed with the survey and refer to the diagram showing how the contamination might occur. They are then asked, "How important would you say that [natural resource group] contamination issues in Montana are to you?"

Next, information is presented about three types of response options for contamination of each of the three resource groups. The first option supplies information on actions that could be undertaken to achieve *complete* cleanup of hazardous substances to restore the injured natural resources and their service flows completely. The second option supplies information on actions that could be undertaken to achieve *partial* cleanup of hazardous substances and partially restore the injured natural resources and their service flows. The third option states an *alternative* action if no cleanup of hazardous substances were to occur, which is to acquire similar resources or resource service flows at another location. For example, respondents are told that if no cleanup of hazardous substances occurs, "land that would provide soil,

vegetation, wildlife habitat, and recreational access similar to the impacted area before it was contaminated could be purchased by the state. These lands would be held in trust by the State to ensure that their natural resources are preserved in the future." Respondents are asked to indicate how satisfied they would be with each option after it is presented. Options two and three are provided to remind respondents that there are substitutes and alternative expenditure possibilities to complete cleanup. The more acceptable partial cleanup or acquisition options are as substitutes for complete cleanup, the more one would expect the value of complete cleanup (or damages from foregone complete cleanup) to be reduced.

2.2.5 About Montana's NPL Sites and About the Clark Fork NPL Sites

As previously noted, it is important to separate values for the cleanup of the Clark Fork NPL sites from values for the cleanup of other hazardous waste sites, and to assist respondents in placing in perspective the importance they may put on cleaning up different hazardous waste sites. The next questions introduce all eight NPL sites in Montana and ask the respondent to rate, from "not at all important" to "extremely important," the importance of cleaning up hazardous substances at each of the sites.

First, the four non-Clark Fork sites are introduced (Q15 through Q18). Respondents are given a brief description of each site, including its size, past and present uses, proximity to population centers, and current status in terms of cleanup activities. Respondents are told to refer to the cover of the survey for the location of these sites within the state. From pretesting, this information proved to be important to respondents when they considered an overall value for cleanup of the Clark Fork River Basin sites, especially when trying to separate values for cleaning up just the Clark Fork River NPL sites from cleanup of all Montana sites.

Next, the four NPL sites in the Clark Fork River Basin are introduced in more detail (Q19 through Q22). Site descriptions and question formats are similar to the information provided for the other four NPL sites, although more detailed information on the size of each site and types of natural resource injuries resulting from the release of hazardous substances is included. This information is provided so that respondents can consider in more detail the kinds of natural resource injuries that have occurred at each of the Clark Fork sites.

2.2.6 Natural Resource Impacts at the Clark Fork NPL Sites

This section of the survey (Q23 through Q25) discusses the specific impacts to natural resources in the Clark Fork River Basin caused by historic and continuing releases of hazardous substances. The information is presented to the respondent for each of the three natural resource groups previously introduced. For example, the first section provides information about impacts to aquatic resources and riparian habitat. Descriptive text includes

information on the approximate amount of surface water that is contaminated, the geographic location of that contamination, and its effects on fisheries, streamside vegetation, and wildlife. The survey information on natural resource injuries at the Clark Fork sites was based on the various injury determination and quantification analyses and reports developed as part of the natural resource injury assessment conducted by the State of Montana.

Along with the written presentations, the respondent is asked to refer to photos in the insert, which are representative of the kind of injuries that have occurred to the natural resources in the Clark Fork River Basin. They are also shown a photo of what the resource might be like if hazardous substances had not been released. This is to remind respondents once again that even if hazardous substances are completely cleaned up, impacts from agriculture, highways, and other human causes will still have occurred and, therefore, the land may not completely return to pristine conditions.

The descriptive text is followed by a question designed to encourage the respondent to think about how often he (or others) uses each resource, and how he is affected by the contamination and will be affected in the future.

2.2.7 How Valuable is Cleaning Up the Clark Fork NPL Sites?

This section presents the detailed WTP valuation scenarios, WTP questions, and follow-up analyses. As a transition to the valuation questions, Question 26 asks respondents to rate in importance use value, bequest value (current and future use by others), and existence value motives for paying to clean up hazardous substances in the Clark Fork River Basin.

The selection of a payment vehicle is an important component of the contingent valuation scenario. The payment vehicle is the means by which respondents pay monies that will ultimately be used to fund changes in natural resource quality. Many CVM studies have found that the selection of the payment vehicle may alter the WTP results. For example, if respondents reject the payment vehicle as not being fair or realistic, they may report WTP numbers (such as $0, a low value, or a refusal to respond) that reflect their attitude about the payment vehicle rather than their value for natural resource restoration. The appropriate interpretation of this result is that characteristics of the payment vehicle (who pays, the reasonableness of collection of payment using this vehicle, etc.) may cause a reported WTP that is less than an individual's maximum WTP value. While there are reasons why individuals may reduce their reported WTP to be less than their maximum WTP for natural resource restoration due to payment vehicle issues, there are no reasons that the selection of a payment vehicle would lead individuals to pay more than their maximum WTP for natural resource restoration, so long as the WTP question is incentive compatible (a payment vehicle could bias values upward if the scenario amounts to voting on what others should pay rather than your household). Therefore, when payment-vehicle bias occurs when reporting a household's WTP, it can only cause the understatement of values for natural resource restoration.

In most CVM studies one payment vehicle is selected, and all respondents are required to use that payment vehicle. To address the impact of payment vehicles, Question 27 identifies several alternative payment vehicles that may be used, and requests that the respondent circle all that he might support. The WTP question then asks for the "most your household would be willing to pay" using the selected payment approaches. The intent of this procedure is both to reduce payment-vehicle rejection leading to false $0 values or rejection WTP responses, and to investigate the impact of the selection of different payment vehicles. Six payment vehicles were identified, which fall into two groups: those that require the respondent, all other households, and industry to pay, and those that would require others but not necessarily the respondent to pay.

Figure 2-2 reproduces the WTP scenario and payment card in Version 1. The scenario includes:

- A summary of what "complete cleanup" would entail and the resulting changes in natural resources (with reference to Q4 for aquatic resources and riparian habitat, Q8 for groundwater, and Q12 for upland soil, vegetation, wildlife, and wildlife habitat). This summary serves to reiterate the "good" that is being purchased in the WTP questions.

- A guarantee that new programs would use the best available technologies and could restore impacted natural resources to the conditions that would have existed if hazardous substances had not been released. The guarantee is provided to reduce concerns about the certainty of provision of the good, an issue that has been identified by Mitchell and Carson (1989), Fischoff and Furby (1988), and others.

- A guarantee that costs would be paid by a combination of households, industry, and government agencies using the payment vehicles chosen in Q27. This reflects practical implementation and the citizens' desire for industry to participate in paying for these programs, establishes the link of ultimate responsibility to *all* citizens to pay at least part of the costs of the programs, and makes clear that all individuals will participate.

- A guarantee that if cleanup efforts cost less than people are willing to pay, the fees would be lowered so that everyone would only pay a share of what complete cleanup actually costs. This is intended to remove incentives to understate maximum WTP for fear that the funds will be collected whether they are needed or not.

The WTP question (Q28) is in terms of the total payment *each year over the next 10 years that your household would be willing to pay.* Annual payments were selected to minimize the impact of one-year income constraints on ability to pay a total amount the individual may be

Figure 2-2
WTP Scenarios and Payment Card in Survey Version 1

Complete Cleanup of the Clark Fork NPL Sites

We would like to know what it would be worth to you and your household to completely clean up hazardous substances at the Clark Fork NPL sites. When answering, assume that:

➢ "Complete cleanup" would include the methods discussed in Q4 for surface water, Q8 for groundwater, and Q12 for soil, vegetation, and wildlife. These methods are summarized briefly below:

- Surface Water: sources of contamination would be removed and streamside vegetation would be replanted. Water quality, fish populations, soil, vegetation, and wildlife habitat would return to normal levels. After cleanup, contaminated rivers that previously looked like photo 1 would look like a combination of photos 2 and 3 (see insert).

- Groundwater: sources of contamination would be isolated from groundwater; contaminated water would be pumped, treated, and reinjected into the ground. After cleanup, the groundwater would no longer be contaminated.

- Soil, Vegetation, and Wildlife: contaminated soil would be removed, and new soil would be imported. Natural vegetation would be replanted, and wildlife habitat would be restored to normal.

➢ New programs would use best available technologies and could be guaranteed to restore impacted natural resources to the conditions that would have occurred if hazardous substances had not been released.

➢ Costs would be paid by a combination of households, industry, and government agencies using the methods you chose in Q27 above.

➢ If cleanup efforts cost less than people are willing to pay, the fees would be lowered so that everyone would only pay a share of what complete cleanup actually costs.

Q28 What is the most your household would be willing to pay each year for 10 years through the methods you selected in Q27 to fund efforts to achieve complete cleanup of hazardous substances the Clark Fork NPL sites in Montana? (Circle the amount you would pay annually for 10 years.)

$0	$3	$10	$40	$125	$450	$1,500	$5,000
$1	$5	$15	$60	$200	$650	$2,250	MORE THAN $5,000
$2	$8	$25	$90	$300	$1,000	$3,300	

Q29 It is important that we understand your response. Please provide any additional comments that help to explain your answer to Q28 above.

_____

_____

willing to pay over multiple years. In a recent study on oil spills (Rowe et al., 1991), results were obtained from separate samples for a lump sum payment approach and for an annual WTP over a five-year payment period. The lump sum value was 2.75 to 4 times larger than the annual payment for each of the five years. These two results are very comparable, with the difference being attributed to discounting of future payments (which will be accounted for in the aggregation analysis when using the results of this study in Chapter 6.0), uncertainty about being in the study location in the future to receive benefits (which is incorporated when using the results of this study in Chapter 6.0 by aggregating only over the current estimated population), and budget constraints in making lump sum payments, which downwardly bias WTP results. To ensure accurate WTP values, the annual payment approach is used in the current study. Further, a ten-year annual payment horizon presents a more credible scenario than collection of monies in a lump sum payment.

The proposed 1994 NOAA and U.S. DOI CVM regulations express a preference for lump-sum payments as opposed to annual payments. Here we use annual payments because such an approach is more credible, because the NOAA and DOI preferences are undefined, and, as discussed above and in detail by the U.S. EPA (1994), because the lump-sum approach is not generally preferred.

The ten-year time horizon is selected as one that is plausible to respondents for cleanup of the site (although it will likely take longer than ten years). However, because a ten-year cleanup results in interim injuries and damages prior to the completion of partial or complete cleanup, the value of the ten-year cleanup will understate damages. For example, for most individuals, the value of restoring a river today would be greater than the value of restoring the river over the next ten or more years, especially if the individual is uncertain about whether he will still be in the area in the future. As a result, the WTP results provide an underestimate of natural resource damages at the Clark Fork NPL sites.

The WTP elicitation employs a payment card approach in which respondents have the option to review a variety of potential alternative payments and choose the best response. The payment card amounts are selected to provide a log scale between $0 and $5,000. The value in the nth cell of the payment card is specifically computed as $\$D_n = 1.5^{(N-1)}$, with $\$D_n$ rounded for presentation convenience (listing a value of $25 versus $25.63, or $650 versus $656.85, is not significant but is less distracting). This approach was selected, as opposed to an open-ended approach, because payment cards tend to have higher item response rates in mail surveys than open-ended WTP questions (for examples, see Rowe et al., 1986; Rowe and Chestnut, 1985; Rowe and Schulze, 1987; and Chestnut and Rowe, 1990a).

Concerns were raised by the NOAA CVM panel that range, centering, and other forms of bias may exist in payment cards (NOAA, 1993). In a recent study that formally tested for payment card design biases, range and centering biases were not found in a payment card following the design used in this study, unless the value range listed on the payment card is inappropriately truncated (Rowe et al., 1995).

2.2.8 WTP Follow-Up Questions

Question 29 recognizes the difficulty in WTP exercises and asks the respondent to provide any additional comments that help to explain his WTP answer. This follow-up question is useful in determining if scenario rejection has occurred, and to identify invalid zero responses. It can also help to identify individuals who are contributing for a "warm glow of giving" effect or who are not stating a value due to a dislike of "big business." Next, Question 30 again recognizes the difficulty with WTP questions and asks respondents to consider whether their WTP responses were for the described cleanup, or in part or in total for other reasons. Question 31 is essentially the second part of Question 30 and asks respondents who say the response is not "just for cleanup at the Clark Fork NPL sites," what percent is just for cleanup at the Clark Fork NPL sites? Question 30 also serves as a second indirect reminder of budget constraints and substitute activities for which monies may be spent.

This approach follows the design in prior work (Chestnut and Rowe, 1990a and Rowe et al., 1992) in which extensive survey context was found to be insufficient to eliminate fully potential *embedding* (or *part-whole*) biases in the reported WTP amount, but where a follow-up question was useful in addressing and correcting any remaining embedding bias. To do so, the reported percentage just for cleanup of the Clark Fork NPL sites alone is used to adjust the stated WTP to compute the adjusted WTP just for the cleanup of interest (denoted ADJWTP throughout the remainder of this report).

Question 32 completes the valuation scenario by partitioning the ADJWTP for cleanup of the Clark Fork NPL sites into the three resource groups used throughout the survey: (1) aquatic resources and riparian habitat; (2) groundwater; and (3) upland soil, vegetation, wildlife, and wildlife habitat. These apportionments are used to compute the value of cleanup of hazardous substances at the Clark Fork NPL sites for each resource.

2.2.9 Partial Cleanup of the Clark Fork NPL Sites

In this section of Survey Version 1 (Q33), a second valuation question asks respondents for their willingness to pay for *partial* cleanup as a percentage of their willingness to pay for complete cleanup of hazardous substances at the Clark Fork NPL sites. To reduce potential scenario rejection, respondents are told that complete cleanup may be too expensive or technically infeasible. Respondents are given a scenario that is identical to the scenario presented in Q28, except that the methods of cleanup at the Clark Fork NPL sites include the descriptions for partial cleanup that were stated in Q5 for aquatic resources and riparian habitat, Q9 for groundwater, and Q13 for upland soil, vegetation, wildlife, and wildlife habitat. The partial cleanup methods and changes in natural resources are briefly described to reiterate the "good" that is being purchased in the WTP questions. The partial cleanup scenarios were designed to reflect or exceed the cleanup actions, or remedies, that the U.S. EPA has selected or that are being proposed and considered by the U.S. EPA and industry.

The difference between the value for partial and complete cleanup activities (and the resulting changes in natural resources) reflects the *residual* damages remaining after the partial cleanup activities have been undertaken.

2.2.10 Responsibility

Question 34 asks respondents how responsible they feel they are to help pay for cleanup at the Clark Fork River Basin. In a prior CVM study (McClelland et al., 1992) respondent responsibility level has been found to be an important determinant of the reported WTP amount. Respondents who feel that the "responsible party" should pay completely for the cleanup are likely to reject the WTP question or to provide $0 values. Protest $0 responses can be detected through the evaluation of written comments and other survey data.

Some respondents who reject responsibility may still report positive WTP amounts, but these amounts may be less than their maximum WTP for natural resource restoration. Such responses may reflect a willingness to cooperate, but a resistance to pay the most it is worth to them because they feel they should not have to pay anything at all. Failure to accept responsibility to pay for natural resource improvements is a scenario design limitation that biases the CVM valuation toward lower values. Question 34 assists in addressing and correcting for scenario rejection bias (see Sections 5.3 and 5.4).

2.2.11 About You and Your Household

The final questions (Q34 through Q44) request standard demographic information that can be related to attitudes and values for cleanup of hazardous substances and can be compared to population data, including length of residence, age, gender, employment status, household size, recycling behavior, membership in environmental organizations, education, and income.

2.3 SURVEY VERSION 2

Version 2 is identical to Version 1 except that in Version 2 respondents are first asked to value partial cleanup in Q28 and then to give a value for complete cleanup in Q33. Thus, the only difference in the two versions is the ordering and scales used in the valuation questions for partial and complete cleanup in the Clark Fork River Basin. The two different versions provide consistency checks on the valuation of the commodity.

2.4 SURVEY PRETESTING AND PEER REVIEW

The development of the survey was an iterative process. Initial drafts were developed by the project team leading to versions used in formal pretesting stages. Peer review was conducted throughout the survey development and pretesting process. As discussed in Appendix B, the pretest process included three formal iterations including verbal protocol interviews and two rounds of pretests in which respondents completed interviews and were debriefed by the survey development team members (see also Table 2-1).

Table 2-1
Survey Pretesting Steps

Effort	When	Where	# Participants
Verbal protocols	Late October 1992	Missoula, MT	15
Self-administered pretests (1)	Late November 1992	Helena and Missoula, MT	80
Self-administered pretests (2)	Mid-December 1992	Helena and Missoula, MT	112

The pretest process had several objectives. These included a process of acquiring a substantial amount of potentially relevant information about natural resource injuries, both in general and at the Clark Fork sites in specific, and formally paring down the information to retain the most critical information that respondents use to evaluate the sites and to form values. This evaluation and selection of information and context is done through the pretesting "retrospective reports" and debriefing of survey respondents as described in Appendix B. Ultimately, the objective is to shorten the instrument to a mailable length or, if this cannot be accomplished, to develop in-person or alternative survey formats.

The pretesting also focused on wording and clarity of information, sources of confusion or protest, and presentation options. Concurrent to the pretesting, the survey team worked with the injury assessment and quantification team to update and define the description of injuries at the Clark Fork sites. While selected pretest results are presented in Appendix B, they are only relied on to understand how results differ across different presentations and to understand the general magnitude of results that might be expected in the final survey. Pretest results generally differ from final results due to on-going changes in survey design, changes in the final information about injuries at the sites, and perhaps most importantly because the small samples of pretest respondents are not necessarily an accurate sample of the statewide population (for example, the pretest respondents all live in Missoula and Helena).

3.0 SURVEY IMPLEMENTATION AND RESPONSE RATES

Residents living throughout the State of Montana were included in the sampling frame for both versions of the contingent valuation survey. Respondents were randomly selected by Survey Sampling, Inc. of Fairfield, Connecticut from listed telephones such that each household in the statewide sampling frame had an equal opportunity of being selected.[1] Overall, the survey has a high response rate and is representative of the population of the State of Montana. Deviations in the results due to nonrespondents and differences in the sample versus the population are found to have small impacts on the valuation of cleanup options for the Clark Fork Basin (see Section 5.4 and Chapter 6.0 for further details).

Respondents were randomly assigned across the two survey versions described in detail in Chapter 2.0. The survey was mailed to 1,500 households, with 750 surveys each of Versions 1 and 2 sent. Both survey versions are included in Appendix A.

3.1 SURVEY IMPLEMENTATION

The mail survey was implemented using a modified Dillman (1978) repeat mail procedure that included the following steps:

1. First full mailing. This included a cover letter about the survey and a copy of the instrument. The letter identified a $20 incentive for the return of the *fully completed* survey. Upon receipt of completed surveys, the $20 incentive checks were mailed to respondents. The survey was mailed on January 26, 1993. A copy of the cover letter is in Appendix A.

2. Reminder postcard. This was sent to all households in the sample to encourage recipients to return the survey. The reminder postcard was sent one week after the survey mailing on February 2, 1993. A copy of the reminder postcard is in Appendix A.

3. First telephone contact. A telephone contact was attempted with all recipients of the mail survey who had not responded. The first phone contact was implemented during the week following February 19, 1993. Those who said they were willing to return the survey were identified for a second mailing if they had discarded their first copy. All who refused to complete the mail survey were asked to answer a few short questions over the telephone (see Section 3.3). Copies of the telephone follow-up questionnaire and instructions

[1] Survey Sampling, Inc. reports that 83 percent of households in Montana have a listed telephone number.

are located in Appendix A. Response rates to the telephone survey are discussed in Section 3.2.

4. Second mailing. This included a new cover letter (also in Appendix A) and another copy of the survey instrument. This survey was mailed to those we had contacted over the telephone who had agreed to fill out the survey if sent another copy, and to those we were not able to contact. This mailing occurred on March 3, 1993.

5. Second telephone contact. Another telephone contact was attempted with all respondents who, in the first telephone contact, had agreed to complete the mail survey, but from whom we had still not received a completed survey. The second contact was to encourage these people either to return the survey we had already sent or to complete a follow-up telephone questionnaire. The calls were made during the week of March 15, 1993. The second telephone contact used the same survey instrument and instructions as the first telephone contact (see Appendix A), except that we did not offer to send them another copy of the mail survey, and there were a few minor changes in the instructions to reflect the fact that we had sent a second copy of the survey.

All mail and telephone implementation was conducted by Hagler Bailly. All data were entered using double-entry coding and verification procedures.

3.2 RESPONSE RATES AND COMPARISON TO POPULATION CHARACTERISTICS

Table 3-1 summarizes the response rates for the two versions of the mail survey and for the telephone survey. The net overall response rate adjusted for bad addresses and the deceased identified with the mail survey effort is 68.1 percent, yielding 845 respondents for the analysis. There is no significant variation in response rates across the survey versions. Because the $20 reward was sent only for fully completed surveys, virtually all of the returned surveys have all questions answered (the item response rate is over 99 percent for all questions except Q44 dealing with income levels, which has an item response rate of about 92 percent, and Q30/Q31 dealing with embedding, which has an item response rate of about 95 percent). Completed mail surveys separated by week of receipt at Hagler Bailly are summarized in Table 3-2.

88 telephone surveys were completed, which account for approximately seven percent of the adjusted sample. Including respondents to the mail and the telephone surveys, the overall response rate adjusted for bad addresses and the deceased is over 75 percent.

Table 3-1
Mail and Telephone Survey Response Rates

I. Mail Survey			
Description	**Total**	**Version 1**	**Version 2**
Questionnaires mailed	1,500	750	750
Bad addresses/moved away	244	121	123
Deceased	15	9	6
Adjusted sample	1,241	620	621
Total response*	1,097	550	547
Useable returns	845	425	420
% of adjusted sample	68.09%	68.55%	67.63%
II. Telephone Survey			
Description	**Total**	**Call 1**	**Call 2**
Calls attempted	885	753	132
Total contacted	655	551	104
Total who promised to return survey	408	342	66
Total who refused to do anything	159	146	13
Total who completed phone survey	88	63	25
% of adjusted sample	7.09%	5.07%	2.02%
III. Mail and Telephone Survey			
Description	**Overall Response**		
Useable completes	933		
% of adjusted sample	75.18%		

* Includes verbal and written refusals to return the mail survey.

Table 3-3 compares key socioeconomic characteristics of the Montana population for people at least 18 years old with those of the sample group. These statistics were computed across both versions of the survey from a total of 845 respondents. Socioeconomic characteristics of the sample are reasonably representative of the population of Montana as a whole. However, there are some notable differences. Males are over-sampled because mailing addresses, based in part on telephone directory listings, are more likely to be in the name of the male head of household. There are 16.5 percent more males in the sample than reported for the population. Persons who are employed full-time are over-sampled as they are more likely to be heads of households. There are 4.6 percent more employed persons in the sample than in the population. There are also more college graduates as a percentage of the sample (33.1 percent) than as a percentage of the population (19.8 percent). Average income levels for the

Table 3-2
Completed Mail Surveys by Week

Week of:	Percent of Total Returned by Version	
	Version 1	Version 2
February 1	31.5%	35.0%
February 8	32.0%	32.6%
February 15	4.5%	4.0%
February 22	0.9%	1.2%
March 1	0.7%	0.2%
March 8*	18.4%	15.7%
March 15	7.5%	6.4%
March 22	3.8%	4.8%
March 29	0.7%	0.0%

* The second mailing went out on March 3, 1993 accounting for the increase in returns the following week.

sample and population are similar. As discussed in Chapter 5.0, variables such as age, gender and income are important determinants of willingness to pay. Impacts on the valuation due to differences between the sample and the population are addressed and corrected for in Section 5.4 and Chapter 6.0. On the whole, these impacts on the aggregate results are small (less than ± 7 percent).

The 56 counties of Montana were grouped into six general regions for comparing the actual population distribution to the sample distribution by region (Q36). The percentages of the sample and the population living in each region are summarized in Table 3-4. The distribution of the sample very accurately represents the distribution of Montana residents. In fact, the percentages divided on the county level are also very accurate. The upper Clark Fork River is in the *Northwest* and *Southwest* regions as defined in Table 3-4. To the degree that the value per household for injuries and cleanup at the Clark Fork sites varies depending on distances from the sites, no bias is introduced through the sample.

3.3 TELEPHONE FOLLOW-UP TO THE MAIL SURVEY

While mail survey response rates are high, bias may still enter the analysis through the self-selection of respondents to the mail survey. This may occur if the characteristics and attitudes of nonrespondents are significantly different from those of respondents. The

Table 3-3
Sample and Population Socioeconomic Characteristics
(for residents ≥ 18 years old)

Variable	Population Characteristics*	Sample Characteristics
Average number of years lived in MT (Q35)	Not Available	36 years N=841
Average age (Q37)	45.32 years	49.04 years N=842
Age distribution (Q37):		
18-24	11.9%	2.8%
25-34	21.5%	14.6%
35-44	22.2%	28.8%
45-54	14.1%	19.6%
55-64	11.8%	12.4%
65 +	18.5%	21.8%
Proportion of males (Q38)	49.5%	66.0% N=843
Employment status (Q39):	(over 16 years)	
% full time	53.4%	58.0%
% part time	18.1%	9.0% N=841
Average household size (Q40)	2.5 people	2.7 people N=844
Percent who are college graduates (Q43)	19.8%	33.1% N=844
1992 household income before taxes (Q44):**		
mean	$32,578	$34,650
median	$26,028	$25,000 N=778

* Source: Montana Department of Commerce, 1992.

** Income is in 1992 dollars. For the population, it is adjusted from 1989 to 1992 using the Consumer Price Index. The population income statistics may be low. Market Statistics (1993) reports estimates of 1992 disposable household income of $28,515 (median) and $34,972 (mean) for Montana. These figures are in 1992 dollars.

Table 3-4
Distribution of the Sample and the Population of Montana by Region

Montana Region	Sample Percent (N = 837)	Population Percent*
Northwest	42.6%	42.6%
Southwest	19.1%	19.0%
North Central	6.7%	7.2%
South Central	21.0%	20.9%
Northeast	6.4%	6.2%
Southeast	4.5%	3.9%

* Source: Montana Department of Commerce, 1991.

Northwest region includes the counties of: Lincoln, Sanders, Mineral, Missoula, Lewis and Clark, Flathead, Lake, Cascade, Teton, Pondera, and Glacier.

Southwest region includes the counties of: Beaverhead, Madison, Deer Lodge, Silver Bow, Ravalli, Granite, Powell, Gallatin, Broadwater, and Jefferson.

North Central region includes the counties of: Toole, Liberty, Hill, Blaine, Phillips, Petroleum, Fergus, Judith Basin, and Chouteau.

South Central region includes the counties of: Meagher, Park, Sweet Grass, Stillwater, Carbon, Big Horn, Yellowstone, Treasure, Musselshell, Golden Valley, and Wheatland.

Northeast region includes the counties of: Valley, Daniels, Sheridan, Roosevelt, Richland, McCone, Dawson, and Garfield.

Southeast region includes the counties of: Carter, Fallon, Wibaux, Prairie, Custer, Powder River, and Rosebud.

telephone survey introduced in Section 3.1 was undertaken to examine the existence, direction, and general magnitude of any potential nonresponse biases. This instrument is a very streamlined version of the mail survey and addresses overall concern with hazardous waste sites and how much effort should be undertaken to cleanup the Clark Fork sites.

Several questions were asked to collect demographic data that is used with econometric results in Chapter 5.0 to predict how WTP values for nonrespondents may differ from WTP values for respondents.

Telephone contact was attempted with those individuals from whom no completed questionnaire had been received and who indicated they would not complete the mail survey, but would be willing to complete a short telephone survey. Data from the telephone survey were also coded using double-entry coding and verification. There are 88 completed phone surveys for residents, which are useful for comparison with the mail respondent group. The 88 telephone respondents account for approximately 7 percent of the adjusted sample and approximately 22 percent of the nonrespondents to the mail survey (adjusted for bad addresses and the deceased).

Table 3-5 reports a summary of statistics for respondents to the telephone and mail surveys. The telephone survey results exhibit differences with respect to the mail survey data. For example, the average importance score for cleaning up hazardous waste sites is slightly lower for the telephone group. This difference may reflect differences in attitudes as well as differences in the amount of information presented in the telephone survey as compared to the mail survey. (Results from the pretest debriefing questions and from Pretest 2 Version 3 indicate that substantial reductions in information will result in reduced WTP values. See Appendices B and C.) The income level for the telephone group is substantially lower than for the mail survey group. The mean and median age for the telephone group is significantly higher. There is also a higher percentage of females who responded to the telephone survey. As reported in Chapter 5.0, gender, income, and age are all significant determinants of willingness to pay for cleanup in the Clark Fork Basin.

Results of the telephone survey provide a good reflection of nonrespondents, but should be interpreted cautiously partly because of the small sample size, the small number of variables collected, failure to contact all mail survey nonrespondents, and refusals to cooperate. Based on the telephone sample of nonrespondents, one would expect nonrespondents to have positive values for cleanup at the Clark Fork NPL sites. However, the values for nonrespondents may be less than for respondents to the mail survey. The magnitude of the potential nonresponse bias on the valuation results is addressed and corrected for in Section 5.4 and Chapter 6.0.

3.4 SUMMARY

Response rates are high for the mail survey. The mail survey sample shows a high correlation of geographic location with the underlying population. Differences between the demographic characteristics of the sample and population could result in biases in the average contingent value statistics calculated for the sample. Additionally, the telephone survey results indicate that differences between respondents to the mail survey and nonrespondents could also bias results. Using the telephone respondents as representative of mail survey nonrespondents suggests that nonresponse bias is small but significant. The magnitudes of these potential sampling and nonresponse biases for the WTP results are quantified in Section 5.4 and are accounted for in the extrapolation of the sample WTP results to the entire Montana population in Chapter 6.0.

Table 3-5
Summary of Telephone Follow-Up Questions

Category/Variable (mail survey question #)	Telephone Survey	Mail Survey
Average importance of cleaning up hazardous waste sites in Montana (Q2)	5.26 (0.188) N=82	5.82 (0.050) N=842
Average number of years lived in Montana (Q35)	48.81 (2.583) N=85	36.03 (0.612) N=841
Average age (Q37) Median	62.30 (2.044) 65 N=87	49.04 (0.537) 46 N=842
Average number of people in the household (Q40)	2.10 (0.129) N=87	2.72 (0.051) N=844
Percentage in income intervals (Q44)*	< $10,000 21.9% $10-19,999 31.5% $20-39,999 32.9% $40-59,999 6.8% $60-80,000 5.5% > $80,000 1.4%	< $10,000 9.0% $10-14,999 9.4% $15-19,999 11.6% $20-29,999 22.0% $30-39,999 19.0% $40-49,999 11.7% $50-59,999 6.9% $60-69,999 3.5% $70-79,999 2.2% $80-99,999 1.7% $100-124,999 1.7% $125-149,999 0.6% $150-200,000 0.3% > $200,000 0.5%
Average household income (Q44)** Median	$25,137 $15,000 N=73	$34,650 $25,000 N=778
Percentage of males (Q38)	31.0% N=87	66.0% N=843

( ) = standard error of the mean.

* Percentages may not sum to 100 percent due to rounding.

** Standard error of the mean is not reported for household income because income is estimated using the midpoint of the income intervals.

4.0 GENERAL ATTITUDES AND OPINION RESULTS

This chapter presents the responses to questions about attitudes, concerns, and familiarity of the respondents with hazardous waste issues and the eight National Priorities List (NPL) sites in Montana. The information will help place in perspective the values for the cleanup of the NPL sites in the upper Clark Fork River Basin. For convenience of presentation, all statistics will refer to the question number as it was presented in survey Version 1. In most cases the questions are identical across both survey versions, and there are no significantly different results for these questions across the two survey versions. Therefore, only aggregate results across the two survey versions are presented. As discussed in Chapter 3.0, the item response rates are 99 percent or higher for all questions (with the exception of income (Q44) where approximately eight percent of respondents did not answer the question, and the questions to detect and correct for embedding (Q30/Q31) where approximately five percent of respondents did not answer).

4.1 FAMILIARITY WITH AND CONCERN ABOUT HAZARDOUS WASTE SITES

Respondents demonstrate a high degree of familiarity with and concern about the Clark Fork NPL sites. To characterize their knowledge of or familiarity with hazardous substance problems at the eight NPL sites in Montana, respondents were asked in Q1 about their awareness of the sites either through seeing, hearing about, or reading about each site. The responses for each of the eight sites are reported in Table 4-1. Nearly three out of four residents are familiar with two sites, and over 50 percent are familiar with at least four of the eight NPL sites. The most familiar sites are the Anaconda Smelter site and the Silver Bow Creek/Butte Area site, with over 70 percent of the sample familiar with these sites. Overall, respondents are more familiar with the Clark Fork sites than the other NPL sites in Montana, although the East Helena site is about as well known as the Milltown Reservoir/Clark Fork River site and is more well known than the Montana Pole site.

To consider the relative importance of cleaning up hazardous waste sites, Q2 compared the importance of cleaning up hazardous waste sites to other selected issues facing residents of Montana. Respondents were asked to rate each issue on a scale from one to seven with one being not at all important and seven being extremely important. Respondents' average responses for all issues are reported in Table 4-2. Cleaning up Montana hazardous waste sites ranks highest among the issues presented but is not statistically significantly different in importance from bringing new jobs to the state. The familiarity with hazardous waste sites and the high degree of importance placed on cleanup would lead one to expect WTP values for hazardous waste site cleanup to be greater than zero and that the WTP values would be based on some familiarity with the sites and issues.

Table 4-1
Residents' Familiarity with Montana NPL Sites (Q1)
(N = 845)

Site	Percent Who Are Familiar with Site	Familiarity Ranking
Silver Bow Creek and Butte Area	70.4%	2
Montana Pole	34.3%	5
Anaconda Smelter	84.3%	1
Milltown Reservoir/Clark Fork River	58.2%	3
East Helena	55.1%	4
Idaho Pole Company	22.6%	7
Mouat Industries	11.5%	8
Libby Groundwater	23.1%	6
Average number of listed sites with which respondents are familiar	3.6 (standard error = 0.070)	—

Table 4-2
Relative Importance of Issues to the Citizens of Montana (Q2)

Issue	Average Level of Importance* (standard error of the mean)		
Improving the education system	5.61	(0.053)	N = 838
Reducing air pollution	5.35	(0.052)	N = 843
Bringing new jobs to the state	5.78	(0.051)	N = 841
Improving public roads and highways	5.08	(0.050)	N = 840
Preserving wilderness areas	4.98	(0.063)	N = 839
Promoting recycling	5.51	(0.052)	N = 837
Cleaning up hazardous substances at sites	5.82	(0.050)	N = 842

* On a scale of 1 = *not at all important* to 7 = *extremely important.*

4.2 ATTITUDES ABOUT HAZARDOUS WASTE IMPACTS AND CLEANUP OPTIONS

Questions 3 through 14 address impacts and cleanup options for three broad resource groups that may be impacted by the release of hazardous substances: (1) aquatic resources and riparian habitat; (2) groundwater; and (3) upland soil, vegetation, wildlife, and wildlife habitat. For each resource group, respondents are presented a discussion of impacts and asked how satisfied they are with: (1) complete cleanup options; (2) partial cleanup options; and (3) alternative "acquisition" options to address resource contamination.

Results for these questions are reported in Table 4-3. Respondents indicate that injuries to all natural resource groups are important to them. Complete cleanup is highly desired while responses to partial cleanup are either neutral or somewhat negative. Respondents are generally not satisfied with the alternative "acquisition" option. From these results one would expect that, aggregated across the entire sample, WTP for complete cleanup would be greater than WTP for partial cleanup, and WTP for partial cleanup would be greater than WTP for alternative acquisition options.

Table 4-3
Attitudes Toward Contamination Issues and Cleanup Alternatives (Q3-Q14)

Affected Resource	Average Importance of Contamination Issue* (standard error of the mean)	Average Level of Satisfaction with Alternatives** (standard error of the mean)		
		Complete	Partial	Alternative
Aquatic resources and riparian habitat	5.88 (0.046) N = 844	5.68 (0.060) N = 843	3.10 (0.056) N = 843	2.43 (0.055) N = 842
Groundwater	5.88 (0.047) N = 844	5.40 (0.061) N = 841	3.19 (0.059) N = 841	2.08 (0.048) N = 839
Upland soil, vegetation, wildlife, and wildlife habitat	5.82 (0.048) N = 844	5.53 (0.061) N = 837	3.38 (0.055) N = 838	2.21 (0.050) N = 839

* On a scale of 1 = *not at all important* to 7 = *extremely important.*
** On a scale of 1 = *not at all satisfied* to 7 = *extremely satisfied.*

4.3 RATINGS OF MONTANA NPL SITES

In Questions 15 through 22, residents were presented with summary details on each of the eight Montana NPL sites, including the Clark Fork sites, and were asked "how important is it to you to clean up hazardous substances at each site." Responses range from one (not at all important) to seven (extremely important). Based on these introductions to the eight sites, cleaning up hazardous substances is rated as more important for the four Clark Fork sites than for the other four Montana sites (see Table 4-4). With the exception of the Montana Pole site, differences between the Clark Fork sites and other sites are statistically significantly different. These responses generally reflect the awareness of the sites as listed in Table 4-1, but not exactly. From these results, one would expect the value of natural resource damages to be greater for the Clark Fork sites than for other sites in Montana. Among the Clark Fork sites, one would expect damages to be greatest for Silver Bow Creek and the Butte area, and then for the Milltown Reservoir/Clark Fork River site.

Table 4-4
Importance of Hazardous Waste Cleanup at Montana NPL Sites (Q15-Q22)

Site	Average Level of Importance* (standard error of the mean)			RANK**
Silver Bow Creek and Butte Area	5.59	(0.055)	N = 844	1
Montana Pole	5.38	(0.054)	N = 842	4
Anaconda Smelter	5.45	(0.057)	N = 844	3
Milltown Reservoir/Clark Fork River	5.53	(0.056)	N = 844	2
East Helena	5.26	(0.056)	N = 841	6
Idaho Pole Company	5.14	(0.056)	N = 843	7
The Mouat Industries	5.10	(0.056)	N = 843	8
Libby Groundwater	5.28	(0.056)	N = 843	5

* On a scale of 1 = *not at all important* to 7 = *extremely important.*

** Rankings are based on average score. Adjacently ranked sites are generally not statistically significantly different.

4.4 USE OF NATURAL RESOURCES

Questions 23 through 25 specifically described the current aquatic resources and riparian habitat; groundwater; and upland soil, vegetation, wildlife, and wildlife habitat resource impacts associated with historic and continuing releases of hazardous substances at the Clark Fork NPL sites. These questions ask residents "how likely is it that you (and others for groundwater)[1] would use [these resources] if they were not affected by hazardous substances?" The average responses are reported in Table 4-5.

Table 4-5
Likely Use of Resources in the Absence of Contamination by Hazardous Substances (Q23-Q25)

Affected Resource	Average Likelihood of Resource Use* (standard error of the mean)	% Stating Use Very to Extremely Likely (score = 6-7)
Aquatic resources and riparian habitat/ Silver Bow Creek and the Clark Fork River	3.39 (0.070) N = 844	19.3%
Groundwater/future use in the Clark Fork Basin**	5.12 (0.056) N = 843	46.6%
Upland soil, vegetation, wildlife, and wildlife habitat/near Anaconda	3.19 (0.065) N = 843	13.6%

* On a scale of 1 = *not at all likely* to 7 = *extremely likely.*
** The question on groundwater asks about the likelihood that anyone would use the resource, not just the respondent, as was asked for the other resource groups.

Overall, the use of these resources is judged somewhat unlikely by respondents except for groundwater, which is rated as somewhat likely. However, a significant proportion of respondents do rate use as very to extremely likely, as reported in Table 4-5. This simply reflects that respondents who live far from the site rated potential future use as "not at all likely," which reduces the mean score, while those who live near the site provided higher ratings. Frequency distributions of the responses to Q23-Q25 are reported in Table 4-6 and illustrate the high variation in responses.

[1] Questions 23 through 25 were provided for context and are designed to encourage the respondent to consider the extent of use of the resource and how the respondent is affected by the contamination and will be affected in the future. The reason Question 24 on groundwater asks about the likelihood that *anyone* would use the resource, not just the respondent, is because groundwater cannot be used for recreation, in contrast to the other two resources.

Table 4-6
Frequency Distribution of the Likelihood of Use of Resources in the Absence of Contamination by Hazardous Substances (Q23-Q25)*

Resource	% Response (by response score)						
	Not At All Likely 1	2	3	4	5	6	Extremely Likely 7
Aquatic resources and riparian habitat	25.1%	17.2%	12.3%	13.1%	12.9%	8.8%	10.5%
Groundwater**	2.8%	5.4%	7.9%	15.2%	21.9%	21.7%	24.9%
Upland soil, vegetation, wildlife, and wildlife habitat	25.5%	18.3%	14.6%	15.9%	12.1%	5.8%	7.8%

* On a scale of 1 = *not at all likely* to 7 = *extremely likely.*
** The question on groundwater asks about the likelihood that anyone would use the resource, not just the respondent, as was asked for the other resource groups.

4.5 MOTIVES FOR REDUCING NATURAL RESOURCE IMPACTS DUE TO HAZARDOUS SUBSTANCES

Question 26 addressed the importance of personal use, bequest, and existence motives for cleaning up hazardous substances and reducing natural resource injuries in the Clark Fork Basin. These results are listed in Table 4-7. Bequest motives tied to use by others now and in the future are most important, with existence motives the next most important.

Consistent with the results of expected natural resource use at the sites (Questions 23-25 reported in Table 4-5), use-related motives are rated significantly lower than other motives. As a result, any assessment focused only on use values is likely to understate significantly the total value residents assign to natural resource injuries at the Clark Fork Basin. Frequency distributions that illustrate the high variation in the responses to Q26 are depicted in Figure 4-1.

4.6 OTHER ENVIRONMENTAL BEHAVIORS

Among the questions asked about the household were two that reflect general environmental behaviors. Q41 asked "in the past month, has your household recycled newspaper, glass, aluminum, or other materials"? Over 82 percent of respondents had recycled materials in the past month. Q42 asked "in the past year, have you held membership or donated time or money to any environmental organizations or groups"? Only 19 percent had supported one or

Table 4-7
Reasons for Cleaning Up Hazardous Wastes in the Clark Fork Basin (Q26)

"To Reduce Impacts to Air, Land, Water, Wildlife, and Fish"	Average Importance of Reason* (standard error of the mean)		
For current use by my family and myself	4.19	(0.075)	N = 842
For current use by others	5.12	(0.057)	N = 842
For use by future generations	5.75	(0.053)	N = 841
Even if no one ever uses them	4.73	(0.071)	N = 840

* On a scale of 1 = *not at all important* to 7 = *extremely important.*

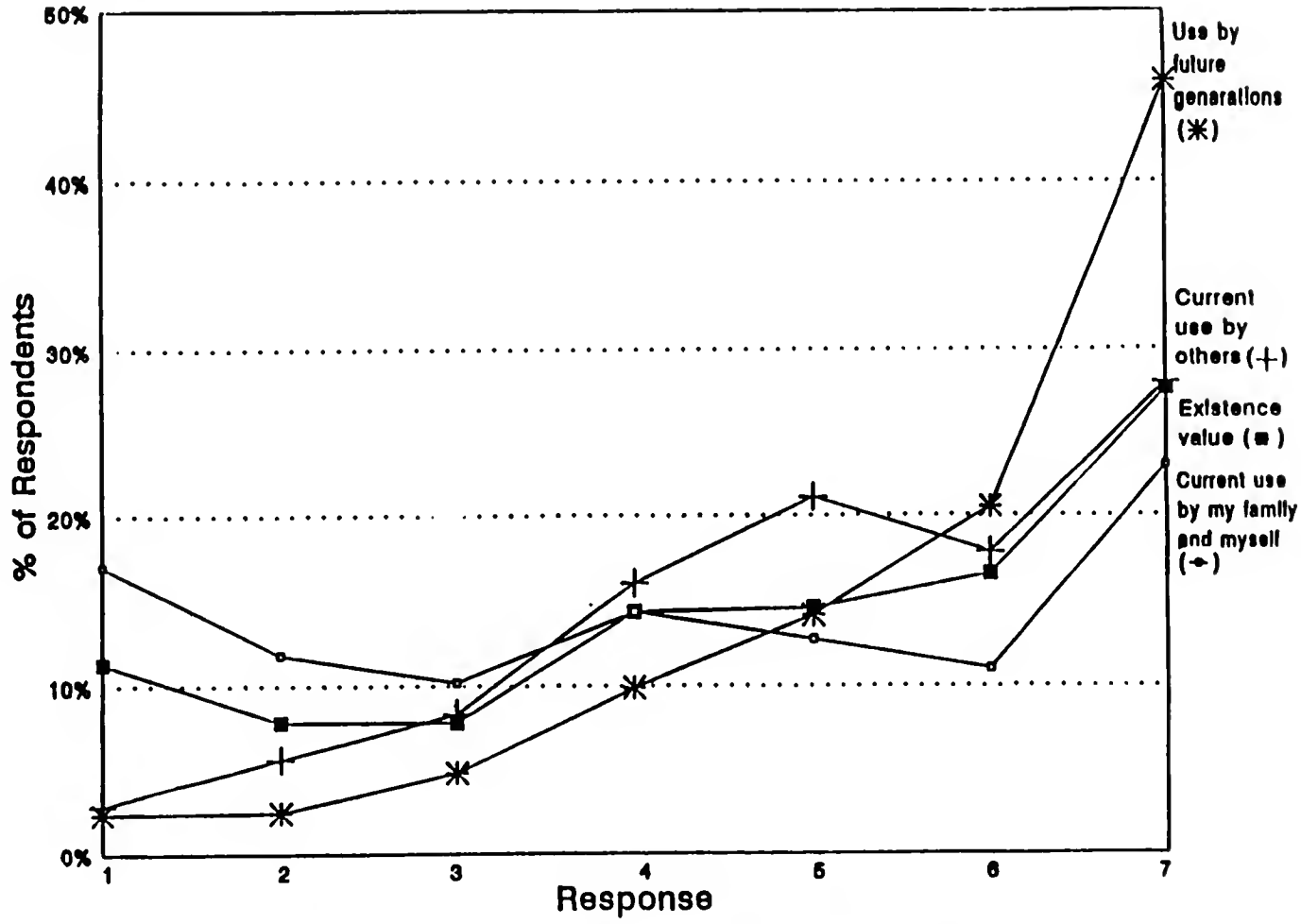
more groups in the past year. Most (81 percent) had not supported any environmental groups. Overall, respondents initiate individual environmental actions but are not actively involved in environmental organizations (i.e., the sample does not appear to be unduly reflective of that portion of the population that is environmentally active). The importance of these variables is further addressed in the WTP econometric analysis in Chapter 5.0.

4.7 SUMMARY

Among the important results reported in this chapter are the following:

- Residents are very aware of the impacted sites in the Clark Fork Basin, and they place much importance on cleanup.
- One would expect contingent values of residents of Montana for cleanup of the Clark Fork sites to be greater than zero and to reflect their awareness of the sites.
- One would expect WTP for cleanup of Montana NPL sites to be largest for the Silver Bow Creek/Butte Area site, and then for the Milltown Reservoir/Clark Fork River site.
- One would expect WTP for complete cleanup to be greater than WTP for partial cleanup or the acquisition option.
- Injuries matter more for bequest and existence motives than for motives tied to one's own use. As a result, it is expected that a use-value assessment would significantly understate total values.

Figure 4-1
Motives for Cleaning Up Hazardous Wastes in the Clark Fork Basin (Q26)



* Motives scored from 1 = *not at all important* to 7 = *extremely important.*

5.0 CONTINGENT VALUATION ANALYSIS

This chapter reports and discusses the results of the contingent valuation questions presented to respondents (Q27-Q34). Values for complete and partial cleanup of hazardous substances at the four Clark Fork NPL sites (Silver Bow Creek/Butte Area site, the Montana Pole site, the Anaconda Smelter site, and the Milltown Reservoir/Clark Fork River site) were derived from each version of the survey. WTP_C and WTP_P indicate the willingness to pay for complete and partial cleanup of the Clark Fork sites, respectively. The two versions of the survey both elicit WTP each year for ten years for complete and partial cleanup.

As discussed in Chapter 2.0, the two versions of the survey differ only with respect to the order in which these two values are elicited. Version 1 asks residents to value complete cleanup of the Clark Fork sites and then proceeds to ask what percent of that value they would be willing to pay to achieve partial cleanup. WTP_C is the response to Q28, and WTP_P is the response to Q28 multiplied by the percentage in Q33. In contrast, Version 2 reverses the order and asks for a value for partial cleanup, and then proceeds to ask how much the value could be inflated to indicate the individual's willingness to pay for complete cleanup. In Version 2, WTP_C is the response to Q28 multiplied by the percent in Q33, and WTP_P is the response to Q28.

Results using consistency check data cleaning procedures and regression outlier analysis are discussed in Sections 5.1 and 5.2. Econometric procedures to investigate the determinants of WTP and to address reporting measurement error are discussed in Section 5.3. Finally, adjustments of WTP to account for sampling and nonresponse biases are addressed and accounted for in Section 5.4. Also addressed and accounted for in Section 5.4 is how self-assessed "responsibility" to pay for site cleanup influences reported WTP values. Scope testing is addressed in Section 5.5.

5.1 DATA HANDLING PROCEDURES

Prior to the analysis of the willingness-to-pay statistics, a number of *consistency checks* proposed by Rowe and Chestnut (1985) were performed on the data to eliminate problematic bids, which extend the zero bid evaluation procedures used in earlier CVM studies (Cummings et al., 1986). CVM responses are considered problematic when they reflect a rejection of the scenario rather than revealing the consumer's surplus value for the change in the resource that is being valued. For example, respondents may indicate a $0 WTP as a rejection of the hazardous substance cleanup scenario or as a rejection of the responsibility to pay rather than as an actual value for cleanup. Similarly, some respondents may overstate their values for cleanup due to lack of consideration of the question or for other reasons. As a result, some WTP responses may be unrealistically high. Large bids are evaluated through regression analysis. These types of problems are common in CVM surveys but need not invalidate the overwhelming majority of valid responses.

Consistency checks are used to identify CVM responses that are inconsistent with other responses given by the respondent, including written comments. Consistency checks can also be used to help evaluate the apparent validity of the overall CVM responses. One would question the validity of the CVM responses if a substantial share of respondents failed rudimentary tests of internal consistency (Fischoff and Furby, 1988). Consistency checks were applied in a manner to yield conservative interpretations of the CVM responses. Specific checks and issues on individual questions are reviewed below. WTP sample statistics, which are calculated using data collected from respondents to the mail survey, are reported for data *cleaned* of problematic responses.

Zero WTP Responses

In CVM studies an effort is made to evaluate $0 WTP responses to determine whether the respondent really means he does not value the hypothetical change being considered, or whether the response reflects some objection to the question and should not be interpreted as a true zero value for the resource change in question. McClelland et al. (1991) suggest that zero responses may also reflect the fact that respondents do not know the value, or do not want to expend the effort required in the exercise and, therefore, opt not to engage in the question.

A typical case of a $0 WTP response that represents a likely protest, or rejection of the CVM scenario, is a respondent who also states that he is quite concerned about the Clark Fork sites (Q19 through Q22), and who indicates that cleaning up hazardous waste sites in Montana is an important issue (Q2). These response patterns are often accompanied by written protest comments and by responses to other questions that suggest that responsibility for payment lies elsewhere than with the household (Q34).

The issue of responsibility to pay for cleanup at the Clark Fork sites is of particular importance. As reported in Table 4-2, respondents express that cleanup of hazardous waste sites is a very important issue. However, as reported later in Table 5-16, one of the most prevalent comments made in Q29, or just after the WTP question, is that industry is responsible for paying for cleanup, not the respondent. This sentiment can be expected to be associated with zero and reduced WTP values. The issue of responsibility is revisited throughout this chapter, and in Section 5.4 it is demonstrated that reported WTP responses significantly underestimate values due to unwillingness to accept responsibility (Q34).

The consistency check approach used to evaluate zero value responses is designed to err on the side of retaining protest $0's rather than dropping actual $0 responses. The following criteria must *all* be met before a $0 response is deleted:

- A written protest comment must have been made indicating objection to the premises of the WTP question. Categories for protest comments are listed in Table 5-1. Requiring a written comment is stringent since not all respondents provided a written comment to explain their WTP responses (27 percent of respondents with $0 WTP did not provide comments).

- The respondent must report substantial concern for one or more of the four Clark Fork NPL sites discussed in the survey instrument. This occurs with a rating of 5 or more on at least one of Q19 through Q22.

- The respondent must indicate that he or she feels that efforts and expenditures allocated to the cleanup of hazardous substances are important by reporting a value of 5 or more in Q2.

Table 5-1
Comment Categories for Protest Bids of $0

A comment indicating rejection of the CVM scenario
I want to know how the money will be used before I pay
I want to know what the total cost is before I pay
I want to know what my fair share is before I pay
Anti-government
No increased taxes
I'm not responsible
Polluters are responsible; make them pay

These criteria are demanding and result in a conservative interpretation of the zero WTP responses. Over 80 percent of the zero bids retained for the analysis met at least one of the three criteria listed above, suggesting that many of the zero bids considered to be valid by the consistency check procedure may also be protest zeros. Table 5-2 demonstrates, for respondents to both versions, that the respondents for whom a zero WTP response is deleted exhibit attitudes about hazardous waste site cleanup that are much more consistent with respondents providing positive WTP responses than with respondents for whom zero WTP values are retained as valid. This further supports the consistency check procedure for testing the validity of zero values as reasonable and appropriate.

Table 5-2
Consistency Check Comparison of Attitudes
About Cleaning Up Hazardous Waste Sites in Montana by WTP Response (Q2)

	Retained as Valid $0	Deleted as Protest $0	Positive, Nonzero WTP
Average score for importance of cleaning up hazardous waste sites (Q2)	4.54 (0.216) N = 89	6.24 (0.121) N = 46	5.95 (0.049) N = 703

( ) Standard error of the mean.

Large WTP Responses

It is sometimes suggested that large bids, often called "outliers," be trimmed prior to calculating sample means and other statistics.[1] For example, Mitchell and Carson (1989) suggest trimming the lowest alpha and highest alpha percent of the reported WTP distribution. They suggest that an alpha of ten percent would yield a very conservative interpretation of the WTP results. Concern with this approach has been noted elsewhere as it deletes high WTP responses regardless of whether the responses are supported by other respondent information such as income, distance to sites, or attitudinal variables (Chestnut and Rowe, 1990a). Morey et al. (1993) also note that actual behavior data on recreation result in WTP distributions that are highly skewed. Here, we use a more formal regression-based analysis that identifies large outliers. This analysis, as described in Section 5.3, models the WTP response as a function of income, distance to the sites, attitudes, and other variables. Observations that result in large positive errors (i.e., the reported WTP value is much larger than the model would predict for the individual) are WTP responses of concern.

Both log-linear and linear regression models were examined. With the log models, very few large bids generated regression errors of concern. In subsequent log-linear econometric models (Section 5.3) all WTP values (except the earlier rejection $0 responses) are retained.

In the linear regression model, 21 WTP responses are trimmed out of the sample (13 WTP_C responses in Version 1 and 8 WTP_P responses in Version 2; if the first WTP response in a survey version is trimmed, the second response is also automatically trimmed). These responses have positive regression errors with studentized t-values exceeding 1.645, a very

[1] Large bids might be considered "large" because they are a high percentage of income, where that level is defined arbitrarily, or absolutely large.

conservative test statistic for identifying outliers. There is at least a ten percent chance that these observations are being incorrectly trimmed out of the sample. All of the trimmed values are "high" bids, in that unadjusted WTP (Q28) is greater than or equal to one percent of income. The trimmed sample, based on eliminating large WTP values identified in the linear regression model, is used to compute the best estimates of the average WTP responses for the sample. See Section 5.3 for more details on outlier analysis. Section 5.3 also demonstrates that the high bids are generally consistent with respondent information using simple statistics (see Table 5-20).

Table 5-3 indicates the numbers of valid $0 bids, protest $0's, high responses, and nonzero bids for Q28 for each version of the survey. In total, about 8 percent of the WTP respondents are removed from the analysis as protest zero values or outlier high values following consistency checks and linear regression analysis.

Table 5-3
Summary of WTP Observations Before and After Consistency Check Cleaning

Number of Observations with Willingness-to-Pay Response (Q28)			
	Version		
	1	2	Total
Raw data	423	418	841
Cleaned data - set 1*	385	389	774
Cleaned data - set 2**	398	397	795
Cleaned Data - Set 1			
# of remaining $0 responses	43	47	90
# of apparent protest $0 responses (deleted)	25	21	46
# of deleted high responses	13	8	21
# of remaining nonzero responses	342	342	684

* Removing protest zeros and high WTP responses.
** Removing protest zeros but including high WTP responses for the lognormal error model (see Section 5.3).

Treatment of Missing Responses

For subsequent analyses in the study, it is important to have an income value for regression analysis (Q44), a percent relating WTP_P to WTP_C (Q33), and a percent of the WTP response just for the cleanup of hazardous substances at the Clark Fork NPL sites (Q31) for every respondent. A few respondents did not provide answers to these questions (8 percent in Q44, 1 percent in Q33, and 5 percent for Q31). As a result, different techniques were employed to predict these values for the purpose of using all of the data possible for the WTP statistics and econometric analysis. It should be noted that predicting missing values has little impact on the results because so few values are missing.

Income was predicted using a linear model for those who provided all of the necessary information. For those who did not, the mean income for the sample was used. The variables used to predict income were age (included with a nonlinear term), level of education, gender, employment status, and number of people in the household. The sample mean percentage was used for missing values in Q33. For those who did not provide a percentage in Q31, means for the percentage were calculated for each of the subsamples who chose responses 2 through 4 in Q30 and were substituted for the missing values. In the event a respondent provided no information in Q30, the mean percentage for Q31 across the entire sample was used.

5.2 BASIC WILLINGNESS-TO-PAY RESULTS

Unadjusted WTP Results

The basic statistical results that follow are based on the data cleaned of protest zeros and questionable large WTP responses as identified through consistency checks and regression analysis. Tables 5-4 and 5-5 report the means and distributions of WTP for complete and partial cleanup, respectively, for both versions. Values in the top half of the tables are annual WTP values for a period of ten years, and are not adjusted to the percent of WTP that is just for cleaning up the Clark Fork NPL sites. Table 5-6 shows the distribution of all responses to Q28 for both versions before and after data trimming. The payment card in Q28 contains 23 values, including the item "More than $5,000." The WTP responses are spread over the entire dollar range presented (except for the $3,300 and above responses), but show an increased frequency in the middle of the range.

Adjusted Willingness to Pay (ADJWTP)

One of the concerns with respect to valuation is that some respondents may be giving a WTP response that reflects a general desire to protect all hazardous waste sites in Montana, or to protect the environment, rather than just a consideration of the scenario of hazardous

Table 5-4
Annual WTP for Complete Cleanup ($ 1993)

	Version	
	1 (N = 385)	2 (N = 389)
	Complete Cleanup	
	Unadjusted	
Mean WTP after cleaning*	$72.46	$96.92
(standard error of the mean)	(4.71)	(8.47)
Minimum	$0	$0
Maximum	$1,000	$1,600
	Adjusted for Embedding	
Mean ADJWTP after cleaning*	$40.00	$50.84
(standard error of the mean)	(2.62)	(4.54)
Minimum	$0	$0
Maximum	$240	$800

* Removing protest zeros and high responses.

Table 5-5
Annual WTP for Partial Cleanup ($ 1993)

	Version	
	1 (N = 385)	2 (N = 389)
	Partial Cleanup	
	Unadjusted	
Mean WTP after cleaning*	$42.01	$72.02
(standard error of the mean)	(3.05)	(5.10)
Minimum	$0	$0
Maximum	$300	$1,000
	Adjusted for Embedding	
Mean ADJWTP after cleaning	$25.78	$37.15
(standard error of the mean)	(2.04)	(2.71)
Minimum	$0	$0
Maximum	$240	$360

* Removing protest zeros and high responses.

Table 5-6
Distribution of Unadjusted WTP (Q28)

Value	Version 1 – WTP_C		Version 2 – WTP_P	
	# Responses Before Cleaning	# Responses After Cleaning	# Responses Before Cleaning	# Responses After Cleaning
$0	68	43	68	47
$1	7	7	6	6
$2	2	2	2	2
$3	10	10	3	3
$5	11	11	12	12
$8	1	1	0	0
$10	53	53	66	66
$15	14	14	11	11
$25	36	36	34	34
$40	27	27	50	50
$60	50	50	28	28
$90	20	20	27	27
$125	59	59	54	54
$200	37	37	31	31
$300	12	12	11	11
$450	7	2	6	5
$650	5	0	2	1
$1,000	2	1	3	1
$1,500	1	0	3	0
$2,250	1	0	1	0
$3,300	0	0	0	0
$5,000	0	0	0	0
> $5,000	0	0	0	0

substance cleanup at the Clark Fork NPL sites. This phenomenon is called *embedding* and can result in upwardly biased estimates of WTP for hazardous substance cleanup (see Chapters 1.0 and 2.0 for further discussion of embedding). The survey is specifically designed to detect and correct for embedding. Q30 asked whether the WTP response is specifically for just the cleanup of hazardous substances in the Clark Fork Basin, or in part for more general purposes. If the entire value is not just for the cleanup scenario, respondents were asked to estimate the percentage of their WTP response that is just for the stated cleanup scenario (Q31). The portion of WTP that is just for cleanup is called *adjusted willingness to pay* (ADJWTP).

Table 5-7 summarizes the responses to Q30. If respondents answered that the WTP response is just for cleaning up the sites in the Clark Fork Basin, then 100 percent of their WTP value is assigned to the cleanup value. Respondents to both versions of the survey acknowledged the potential for embedding and made significant adjustments to correct for it. The results to this follow-up question suggest that respondents can use the question to help address and adjust for embedding problems. The results in terms of general adjustment are very similar for both versions, so results in Table 5-7 are reported for combined data from both survey versions.

ADJWTP for each survey respondent is calculated by multiplying the total bid by the percent of total WTP that would be just for the cleanup of hazardous substances in the Clark Fork Basin (from Q31). Statistics for complete and partial ADJWTP are also presented in Tables 5-4 and 5-5. They are based on a clean data set with protest zeros and high bids removed. Further, as discussed at the end of Section 5.3, the process of deleting large WTP responses may be overly conservative (deleting too many large WTP responses).

The proposed NOAA and DOI CVM regulations include a calibration factor of 50 percent. That is, WTP values are reduced by 50 percent. This proposed calibration factor is both poorly founded and unclear as to its application (U.S. EPA, 1994). Our procedure of removing large WTP values and adjusting values with Q30 and Q31 is well-defined and motivated and results in ADJWTP values that are substantially reduced from the raw WTP responses. To subsequently apply another calibration factor would be double correcting for potential embedding factors.

Both unadjusted and adjusted WTP values systematically vary with the response to Q30 on whether the responses are just for clean up at the Clark Fork NPL sites. Values for ADJWTP generally fall for respondents who have difficulty separating values for the Clark Fork sites from other hazardous waste site cleanup or other environmental causes. This is evident in Table 5-8, where the average WTP and ADJWTP values for complete cleanup (Version 1 only) for each of the choices in Q30 are presented. Additionally, simple correlation coefficients reveal that respondents with higher income (Q44), higher self-assessed responsibility rating (Q34), and those who live closer to the Clark Fork NPL sites (Q36) are less likely to embed their values for cleanup at the Clark Fork Basin with values to clean up

Table 5-7
Summary of WTP Allocation by Stated Purpose (Q30 and Q31)

Question: **Would you say the dollar amount in Q28 you stated your household would be willing to pay is:**

Response (Q30)	% of Responses	Mean % Allocated to Cleanup (Q31)
Just for cleanup at the Clark Fork River Basin	16.9% N = 121	100%
Partly for cleanup at the Clark Fork River Basin and partly to cleanup other hazardous waste sites	34.5% N = 248	51.21%
Basically a contribution for all environmental or other causes	39.6% N = 284	35.16%
Other	4.5% N = 32	49.84%
Response missing to Q30, but Q31 response is present	4.6% N = 33	60.15%
Average percent allocated to just the described cleanup of hazardous substances in the Clark Fork Basin	N = 718	53.43% (std. err. = 1.16)

Table 5-8
Summary of Average WTP and ADJWTP by Response to Q30
(complete WTP; Version 1 only)

Question: **Would you say the dollar amount in Q28 you stated your household would be willing to pay is:**

Response (Q30)	Unadjusted WTP (standard error)	Adjusted WTP (standard error)
Just for cleanup at the Clark Fork River Basin	$70.77 (7.82)	$70.77 (7.82)
Partly for cleanup at the Clark Fork River Basin and partly to clean up other hazardous waste sites	$100.99 (7.65)	$55.20 (5.23)
Basically a contribution for all environmental or other causes	$74.84 (9.83)	$29.24 (3.62)
Other	$22.90 (6.86)	$11.93 (3.77)

all hazardous waste sites in Montana or to protect the environment in general. In essence, respondents who are more familiar with the sites have higher cleanup values and are less subject to embedding difficulties. Respondents who reject responsibility to participate in paying for site cleanup are more likely to report WTP values that embed values for other causes, which they recognize in the embedding correction question.

Ratio of Partial WTP to Complete WTP

Note that the ratio of average $ADJWTP_P$ to average $ADJWTP_C$ is 64 percent in Version 1 and 73 percent in Version 2. This is a consistent finding, even though the value elicitation order is different for the two versions (see Chapter 2.0 and the introduction to this chapter). The fact that the 73 percent ratio from Version 2 is greater than the 64 percent ratio from Version 1 may reflect differences in the adjustment scales used in Question 33 to derive values for partial cleanup (Version 1) and complete cleanup (Version 2).

Residual Willingness to Pay

Residual WTP is calculated for each respondent by subtracting WTP for partial cleanup from WTP for complete cleanup. Residual WTP is what residents would be willing to pay for complete cleanup over and above the partial cleanup scenario presented to respondents. This is a measure of *residual damages* if the partial cleanup scenario is actually undertaken. Residual WTP will be used in many of the analyses that follow, and mean values for adjusted residual WTP will be used to calculate aggregate residual damages in Chapter 6.0. Note that the average differences between partial and complete WTP (i.e., average residual WTP values) are very similar across the two survey versions. Sample statistics for cleaned residual WTP, unadjusted and adjusted for embedding, are reported in Table 5-9.

Our results suggest that the average ADJWTP value for complete cleanup ranges from $40 to $51 per household in the sample, while the average ADJWTP value for partial cleanup ranges from $26 to $37 per household in the sample. Average residual ADJWTP for cleanup of the Clark Fork sites is $14 per household in the sample.[2] The order in which the WTP_C and WTP_P values are elicited has an impact on the reported values. When asked first, WTP_C and WTP_P are similar. However, the difference between WTP_C and WTP_P (i.e., residual WTP) is consistent in both survey versions. This may reflect that respondents have somewhat more measurement error in selecting a WTP amount for complete or partial cleanup than they have in determining the difference in value they assign when comparing two scenarios. Results

[2] An alternative way to calculate average residual ADJWTP is to calculate average complete ADJWTP and average partial ADJWTP for each survey version and then subtract the average value for partial cleanup from the average value for complete cleanup. This can be performed within versions or across versions. The calculations within versions yield the same results of $14 that are reported. Comparing values for partial or complete cleanup across versions is not as statistically reliable as comparing these values within versions (see Section 5.5, Appendix E, and U.S. EPA, 1994).

Table 5-9
Annual WTP for Residual Cleanup ($ 1993)

	Version	
	1 (N = 385)	2 (N = 389)
	Residual Cleanup	
	Unadjusted	
Mean WTP after cleaning*	$30.46	$24.91
(standard error of the mean)	(3.34)	(5.57)
Minimum	$0	$0
Maximum	$900	$1,400
	Adjusted for Embedding	
Mean ADJWTP after cleaning*	$14.22	$13.69
(standard error of the mean)	(1.39)	(2.89)
Minimum	$0	$0
Maximum	$180	$700

* Removing protest zeros and high responses.

from both survey versions indicate a significant WTP for both partial and complete cleanup at the Clark Fork NPL sites, and that average ADJWTP for complete cleanup is worth 37 to 55 percent more than partial cleanup.

Allocation of WTP to Resource Cleanup

Respondents were asked in Q32 to indicate how they think the amount they would be willing to pay for cleanup of the Clark Fork sites should be allocated to the three natural resource groups. The average responses to Q32 are summarized in Table 5-10 for those respondents in the cleaned data group answering Q32 completely. The results indicate respondents split their values almost evenly between the three resource groups: aquatic resources and riparian habitat; groundwater; and upland soil, vegetation, wildlife, and wildlife habitat. Respondents have a slight preference toward the cleanup of aquatic resources and riparian habitat. These results are consistent with the nearly equal importance ratings residents placed on each of the resource groups in earlier questions (see Table 4-3).

However, there is great variation among the responses to Q32. Also presented in Table 5-10 are the percentages of respondents to each version who would allocate 50 percent or more of the WTP bid for cleanup to each specific resource group. A substantial number of respondents allocated 50 percent or more to one of the three main resource groups, illustrating

Table 5-10
Percent of ADJWTP Allocated to Cleanup of Specific Resource Groups (Q32)

Resource	Mean Allocation (standard error of the mean)		Percent of Respondents Who Allocated ≥ 50% of WTP to Each Resource Group	
	Version 1*	Version 2*	Version 1*	Version 2*
Aquatic resources and riparian habitat cleanup	32.98% (0.91)	33.44% (0.81)	15.1%	17.5%
Groundwater cleanup	30.98% (0.91)	31.54% (0.88)	15.8%	15.4%
Upland soil, vegetation, wildlife, and wildlife habitat cleanup	29.71% (0.83)	28.64% (0.79)	11.5%	9.4%
Other impacts**	6.29% (0.90)	6.36% (0.82)	3.0%	1.8%

* Number of observations: Version 1 = 329, Version 2 = 330.
** Other resources frequently mentioned include: prevention/education, Anaconda site cleanup, recreation site cleanup, and other factors associated with the three resource groups.

considerable variation in responses that averages out to equal shares. Mean cleaned ADJWTP values for complete cleanup for the various resource groups are presented in Table 5-11. "Other impacts" in these two tables generally include resources that are specific examples of, or are somehow related to, the three broad categories.

Alternative Payment Vehicles and Responsibility

To avoid nonresponse or WTP bias due to respondent protest to any individual payment vehicle, respondents were asked about their preferences for alternative payment vehicles to support additional cleanup at the sites (Q27). Respondents were told that the additional revenues raised would go *only* to the Clark Fork sites, and that the responsible industry as well as the United States Environmental Protection Agency would continue to contribute to cleanup efforts. A summary of the responses to Q27 is presented in Table 5-12. The most acceptable vehicle for raising funds is an increase in waste disposal fees and taxes paid by industry, with some of these costs passed on to customers through higher prices. This is a typical CVM payment vehicle scenario. However, about one third of respondents did not choose this vehicle, but generally prefer other vehicles.

In some cases these other vehicles would require payments by someone else other than the respondent. It is likely these other payment vehicles are a form of scenario protest or free rider behavior in that they enable the individual to pay little or nothing for site cleanup. We created a variable called OTHERPAY to proxy whether a respondent wanted others to pay for

Table 5-11
Average Annual ADJWTP ($ 1993) Allocated to Cleanup of Specific Resources (Q32)
(standard error of the mean)

Resource	Version 1 Complete Cleanup (N = 332)*	Version 2 Complete Cleanup (N = 334)*
Aquatic resources and riparian habitat cleanup	$14.61 (1.02)	$19.38 (1.73)
Groundwater cleanup	$14.45 (1.12)	$18.53 (2.11)
Upland soil, vegetation, wildlife, and wildlife habitat cleanup	$13.04 (0.93)	$17.31 (1.82)
Other impacts	$1.41 (0.25)	$2.28 (0.71)

* There are more observations in this table than in Table 5-10 because valid zero values were included in calculations of WTP values even if Q32 was unanswered. For these zero values, a weight of 33.33 percent was placed on each resource group.

Table 5-12
Support for Alternative Payment Vehicles (Q27)
(N = 826)

	Payment Vehicle (multiple selections allowed)	Percent of Respondents Indicating Support
1.	Increase in waste disposal fees and taxes paid by industry and passed on to consumer in the form of higher prices.	68.5%
2.	Increase in waste disposal bills you pay	39.5%
3.	Increase in water bills you pay	22.4%
4.	Increase in state taxes you pay	21.7%
5.	Increase in the cost of hunting and fishing licenses	52.4%
6.	Highway tolls on residents and nonresidents using I-90 in the affected area	30.5%
7.	Other*	31.2%

* Other vehicles frequently mentioned include: tourist taxes, donations, payments by responsible parties, user fees, funneling monies from inefficient government programs, and other special taxes, bonds, and lottery funds.

cleanup. OTHERPAY equals zero if a respondent selected any of the payment vehicles 1 through 4 in Table 5-12, and equals one otherwise. Thus, OTHERPAY equals zero if the respondent selected one or more vehicles that would place payment burden directly on his or her own household, while OTHERPAY equals one if the respondent did not answer the question or selected a payment vehicle that would require others to pay and would not necessarily require the respondent to pay. In essence, if OTHERPAY equals one, it may reflect either a feeling of nonresponsibility to pay for cleanup, or that others who will benefit should pay. In Table 5-13, mean ADJWTP values for partial, complete, and residual cleanup are presented for the two groups divided on the variable OTHERPAY for both survey versions. Values are between three to eighteen times higher for the group for whom OTHERPAY equals zero.[3]

Table 5-13
Mean Annual WTP Statistics ($ 1993)
Separated by Whether Respondent Indicates Desire for Others to Pay (Q27)

	OTHERPAY = 0		OTHERPAY = 1	
OTHERPAY Variable*	**Version 1**	**Version 2**	**Version 1**	**Version 2**
Complete ADJWTP	$63.72 (6.73, 341)	$83.73 (13.34, 332)	$8.83 (2.35, 82)	$21.36 (6.90, 86)
Partial ADJWTP	$42.71 (5.71, 341)	$60.87 (8.96, 332)	$4.99 (1.49, 82)	$20.11 (6.86, 86)
Residual ADJWTP	$21.01 (2.55, 341)	$22.87 (6.24, 332)	$3.84 (1.25, 82)	$1.25 (0.68, 86)

( ) Standard error of the mean, NOBS.

* OTHERPAY = 0 if respondent chose a payment vehicle in Q27 that requires his or her household to pay (i.e., an increase in the cost of products, trash removal, water, or taxes). Otherwise OTHERPAY = 1. Raw, untrimmed WTP responses are used for this analysis.

[3] Raw data were used for these calculations (i.e., no observations were removed due to consistency check cleaning criteria). The purpose of this section is to illustrate how choosing a payment vehicle that does not require the respondent to pay can reveal a type of scenario rejection that can downwardly bias WTP responses. 52 percent of respondents with zero bids for whom OTHERPAY equals one were cleaned by consistency checks.

The lower values for the group with OTHERPAY equal to one might reflect an unwillingness to accept responsibility for the cleanup of hazardous substances in the Clark Fork Basin. Such a denial of responsibility is likely to bias values downward (reported values will be less than true values). Indeed, responses from Q34, which asks "do you feel responsible to help pay for cleanup at the Clark Fork River Basin," are negatively correlated with OTHERPAY, indicating those wanting others to pay also do not feel responsible for cleanup.[4] Also, OTHERPAY is more likely to equal one for those who live far from the Clark Fork Basin and for those who made a protest comment like those listed in Table 5-1.

Level of responsibility is included as a variable in the econometric analysis in Section 5.3. Results indicate responsibility has a strong positive effect on contingent values. In other words, reported WTP is greatly downwardly biased if respondents do not feel they should have to pay, which is a type of scenario rejection. The sample mean level of responsibility in Q34 is only 2.6 on a scale from one to seven with one equal to "not at all responsible" and seven equal to "extremely responsible." In Section 5.4, we investigate how values would likely increase if all respondents who feel little or no responsibility to help pay (score = 1 or 2) felt at least moderately responsible for cleanup. The results suggest values would increase substantially. Additionally, discriminant analysis demonstrates that the responsibility rating is negatively correlated with OTHERPAY and the presence of a protest comment.

Distance and WTP

One-way driving distances between the CVM survey respondents' counties of residence to the Clark Fork NPL sites, using major roads and highways, were approximated by using estimates from the largest cities or towns within the counties in which they live to the central area of the injured region. The respondents were then grouped into distance shells (concentric rings) in increments of 100 driving miles. Mean annual ADJWTP was then calculated for complete and residual cleanup for each distance shell.

There is a noticeable relationship between distance and WTP. WTP does not, however, tail off completely as distance increases. The residents within 100 miles are willing to pay significantly more than everyone else, but the averages for other shells are substantially greater than zero, even for residents over 500 miles away. Tables 5-14 and 5-15 provide statistics by distance for complete and residual cleanup, respectively. The treatment of distance in the econometric models in the next section is consistent with the results in this section.

[4] The Pearson correlation coefficient is approximately -0.25 with a probability of equaling zero of less than 0.0001.

Table 5-14
Mean Annual ADJWTP ($ 1993) for Complete Cleanup by Distance
(standard error of the mean, NOBS)

One-Way Driving Distance	Survey Version 1	Survey Version 2
0-100 miles	$57.34 (5.69, 121)	$89.13 (11.41, 125)
101-200 miles	$34.40 (3.96, 127)	$40.47 (6.05, 122)
201-300 miles	$33.29 (4.88, 87)	$28.36 (4.61, 92)
301-400 miles	$27.54 (10.73, 15)	$24.50 (11.47, 12)
401-500 miles	$24.96 (6.07, 21)	$23.20 (9.34, 27)
more than 500 miles	$18.51 (10.45, 14)	$15.45 (8.65, 11)

Table 5-15
Mean Annual ADJWTP ($ 1993) for Residual Cleanup by Distance
(standard error of the mean, NOBS)

One-Way Driving Distance	Survey Version 1	Survey Version 2
0-100 miles	$18.86 (3.08, 121)	$28.84 (8.16, 125)
101-200 miles	$13.22 (2.07, 127)	$8.47 (3.10, 122)
201-300 miles	$12.35 (2.93, 87)	$6.23 (2.21, 92)
301-400 miles	$13.30 (4.67, 15)	$5.00 (5.00, 12)
401-500 miles	$10.19 (3.24, 21)	$2.00 (2.00, 27)
more than 500 miles	$1.98 (1.00, 14)	$0.00 (0.00, 11)

There is a large number of nonresidents closer to the site than many Montana residents. For example, if a circle is drawn with a radius of travel distance equal to 500 miles from the Clark Fork Basin, Montana is less than one-third of the total area, and the rest is composed of other states and Canadian provinces (including virtually all of Wyoming and Idaho, the Provo/Salt Lake area, the west half of Oregon, and much of Washington). Even if these non-Montana residents had relatively small but positive values for cleaning up the Clark Fork NPL sites, the total WTP by nonresidents could be very substantial. Not including nonresidents in our analysis will cause the total damage estimates to be understated. For comparison, Sutherland and Walsh (1985) estimated approximately one-sixth of total WTP to protect water quality in Flathead River and Lake (in Montana) was by Montana residents, and the remaining five-sixths of total WTP was by nonresidents.

Date of Survey Receipt and WTP

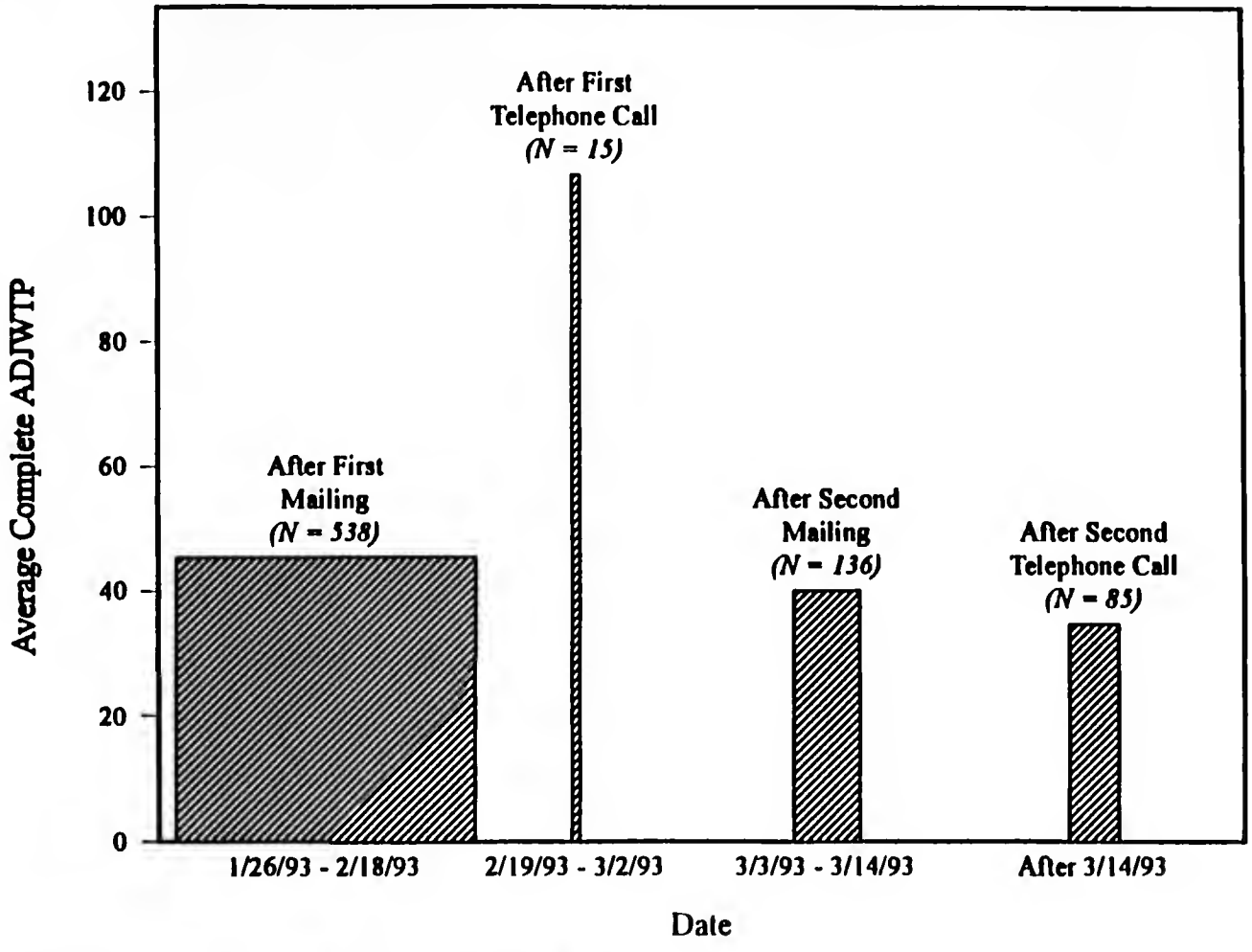
One hypothesis in the CVM literature is that respondents who respond early to the WTP survey are those individuals more concerned about the topic, while those who do not respond may not be concerned at all, or have $0 values. To examine this hypothesis, we computed the mean WTP values for those individuals who responded at different times to the survey: after the first mailing, and after the two telephone contacts and repeat mailings. Average ADJWTP for complete and residual cleanup for these time periods are depicted in Figures 5-1 and 5-2. These figures show that the average WTP value for early respondents is almost the same as for respondents who returned their surveys after the second telephone call. The WTP values do not significantly decline as the repeated survey contacts resulted in more response. A simple regression of WTP on the date the survey was received by Hagler Bailly is not statistically significant.

Comments

Respondents were encouraged to provide written comments on the survey. Some of these comments were used to identify protest bids and are listed in Table 5-1. The remaining comments were categorized and recorded to document response attitudes. The particular comment categories and the number of responses associated with each comment are presented in Table 5-16. Seventy-three percent of the sample provided at least one comment, and a total of 1,351 comments were made. The most prevalent type of comment (258 made) was simply an affirmation of the WTP response. These comments frequently referenced the respondent's income level as a determinant of WTP. This is reassuring in that it reaffirms the reasonableness of the WTP responses for a large proportion of the sample.

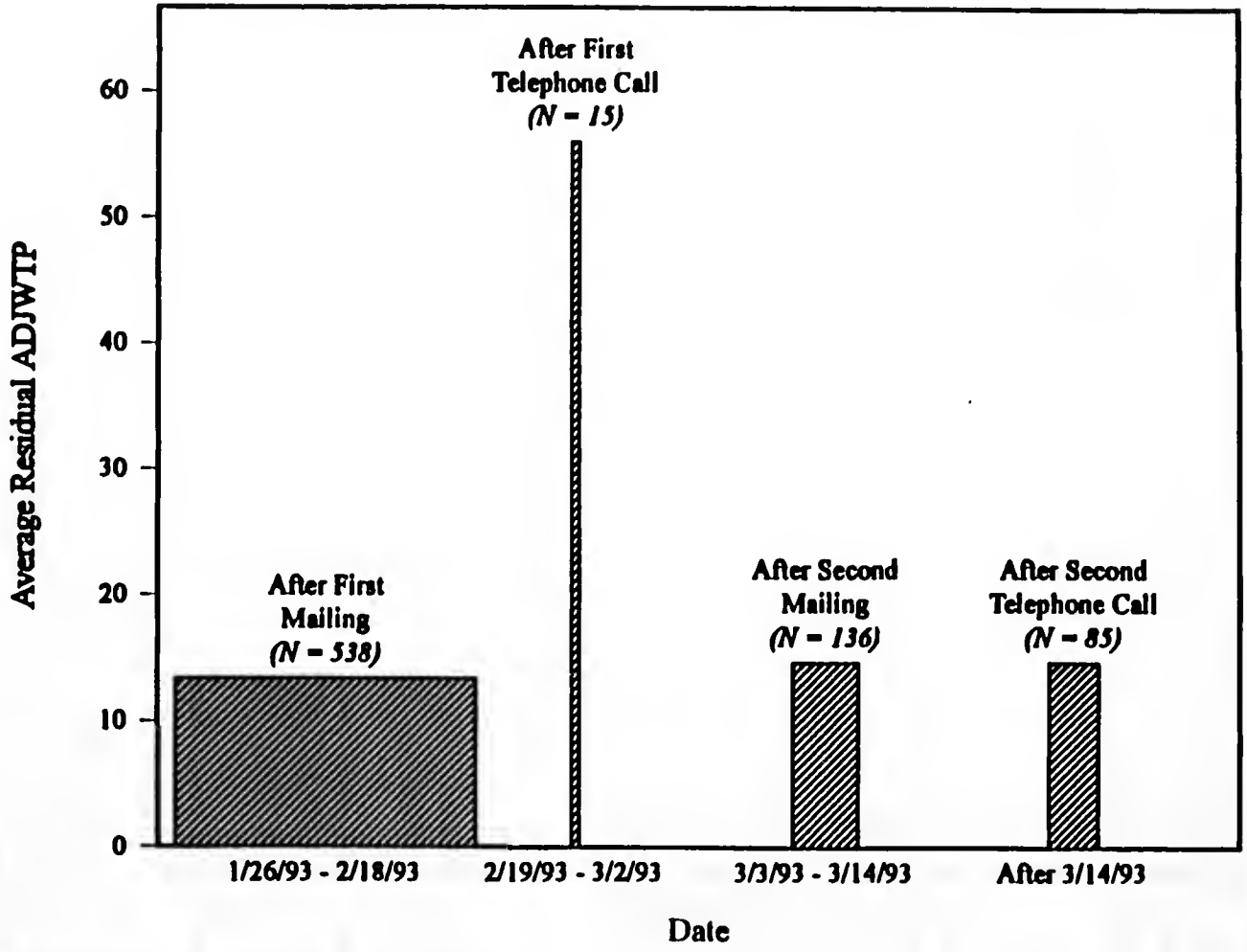
Over thirty percent of all respondents made a protest comment like those in Table 5-1. Such comments include rejection of the WTP scenario as well as refusals to accept responsibility. A total of 206 comments were made that simply say "make the polluter pay; it's not my fault" or "I'm not responsible." Of all of the respondents in the cleaned data, over 26 percent made a protest comment, which suggests that many of the respondents retained for analysis may

Figure 5-1
Average Complete ADJWTP (combined versions) by Date of Receipt of Surveys



Note: Width of boxes is proportional to number of observations.

Figure 5-2
Average Residual ADJWTP (combined versions) by Date of Receipt of Surveys



Note: Width of boxes is proportional to number of observations.

Table 5-16
Comments from the Mail Survey (N=618)

Comment	Times Made
Reasonable given my income/reaffirm amount pledged	258
Make polluter pay/not my fault	175
General environmental concern	127
Everyone should pay	70
Increase preventative behavior	32
I am not responsible	31
Don't believe WTP scenario	31
Pass laws to protect any further destruction	25
No new taxes	25
I want to know what the total cost is for cleanup	23
Can't afford to help/pay	19
Anti-government	19
Give our $20 to cleanup effort	17
User fees could be collected to raise money	15
Partial cleanup absurd/would pay more for complete cleanup	15
Sites don't affect me	15
Look for most cost effective solution to problem	13
Survey is poorly done	13
Nature will heal itself	12
I want to know how the money will be spent	12
Thanks for the opportunity to help	12
Good job done on survey	11
Cleanup itself will cause more pollution than currently exists	11
Increase taxes to everyone	11
I don't use the sites	9
Those most impacted should bear greatest cost of cleanup	9
Start cleanup immediately	9
Make tourists pay	9
Increase product/service prices to pay for cleanup of waste	9
Happy to pay and help clean up	8
I don't care about the sites	7
Use funds collected from implementing ideas on Q27	7
Clean one site at a time until all sites are cleaned, starting with most important	7

Table 5-16
Comments from the Mail Survey -- Continued

Comment	Times Made
I want to know what my fair share is	7
The EPA/government should pay	6
There are more important things to address than waste problems	6
Everyone is at fault	6
Use inefficiently-used government money to pay for cleanup	5
Increase public awareness of problem	5
Increase trash removal costs to pay for cleanup	5
Divert tax money to pay for cleanup	5
General anger at survey as waste of time and money	4
Don't over clean, some pollution is normal	4
Everyone should pay	4
Water quality issue important concern to me	4
Cleanup to pre-industry level impossible	4
I refuse to pay anything	3
We must do much more than the survey has focused on	3
Those closest to site should pay	3
Change of address included	3
Not industry's fault; part of process	2
I make many other environmental contributions	2
I want complete cleanup	2
Mining laws need to be changed to address pollution issues	2
I am currently doing my share to clean toxic waste problems	2
Set up Montana earth fund	2
Areas not used by humans unimportant so no need to clean up	2
Organize community groups to clean sites	1
Increase payment time period past 10 years	1
Give tax incentive to those who clean up	1
Livestock and food issues are being overlooked	1
Forest service is at fault for allowing destruction	1
Most contaminated land private, so not a public problem	1
Donations will not be enough	1
Environmental groups should pay for cleanup	1
Miscellaneous comment	186

have downwardly biased WTP values. These results support the need to adjust values upward to account for respondents' rejection of responsibility to participate in paying for cleanup at the Clark Fork NPL sites (this is addressed in Section 5.4). The significant number of anti-government comments (19 made) also suggests that WTP may be biased downward.

5.3 ECONOMETRIC ANALYSIS OF WILLINGNESS TO PAY

In this section, econometric regression analysis is employed to investigate and quantify the influences of survey design factors and respondent characteristics on individual household WTP responses. We undertake an alternative lognormal error model data correction procedure to compute lower bound WTP results. Willingness to pay for each household can be expected to be a function of the characteristics of the household, their attitudes about the importance of cleaning up hazardous substances and who should pay, and their attitudes about the environment.

The WTP function has a direct relationship with the household's utility function (i.e., the mathematical relationship between well-being and income and other goods and services) in that WTP is a representation of the change in income that would keep utility constant in the event of a change in the environmental quality in the Clark Fork Basin. For illustration purposes, one possible form of the utility function is:

$$U = \alpha \times f(C) + \beta \times g(X) \times f(C) + \gamma \times (Y) \qquad (5\text{-}1)$$

where:

U	=	household utility
f(C)	=	some function of contamination and injuries
g(X)	=	some function of a vector X of the individual's and household's socioeconomic characteristics (age, gender, etc.) and attitudes that influence the effect of cleanup on the household's utility
Y	=	income
α, β, γ	=	coefficient vectors.

WTP is defined as the amount of money that exactly offsets the change in utility obtained by increasing site quality:

$$U(C_1, X, Y) = U(C_2, X, Y - WTP) \qquad (5\text{-}2)$$

The WTP function for a change in the level of hazardous substances (and natural resource injuries) at the Clark Fork Basin from level C_1 to a lower level C_2 derived from utility function (5-1) is:

$$WTP = \alpha \times [f(C_2) - f(C_1)] + \beta \times g(X) \times [f(C_2) - f(C_1)] \quad (5\text{-}3)$$

where α and β are coefficient vectors.

For the econometric analysis, the percentage of WTP allocated just for the stated cleanup of the Clark Fork NPL sites is the relevant variable, so we use ADJWTP. Further, the function f(.) is unknown, but we assume that utility increases with decreases in hazardous substances at the Clark Fork Basin. For simplicity we can analyze ADJWTP for partial and complete cleanup as separate models. With this simplification the term $[f(C_2) - f(C_1)]$ becomes a constant, the specification of the f(.) function can be avoided, and the ADJWTP equation simplifies to:

$$ADJWTP = \alpha^1 + \beta^1 \times g(X) \quad (5\text{-}4)$$

where:

α^1 = the constant term, which is different for each ADJWTP model
β^1 = coefficients on the socioeconomic and attitude characteristics of the individual, which differ for each ADJWTP model.

Determinants of ADJWTP

The specific variables considered to explain the variation in ADJWTP are listed in Table 5-17. An index variable to gauge a respondent's concern for cleaning up specific Clark Fork NPL sites (SITE IMPORTANCE SUM = SIS) was created by adding the scores of Q19 through Q22. It is expected that an increase in SIS would be correlated with higher ADJWTP. An index variable to gauge a respondent's concern for different contamination issues (ISSUE IMPORTANCE SUM = IIS) was calculated by summing scores from Q3, Q7, and Q11. The three specific issues are aquatic resources and riparian habitat contamination; groundwater contamination; and upland soil, vegetation, wildlife, and wildlife habitat contamination. It is expected that an increase in IIS would lead to an increase in ADJWTP. Another index variable to gauge the likelihood of the respondent's use of resources in the Clark Fork River Basin if they were not contaminated (USE-LIKELIHOOD SUM = ULS) was created by adding the responses to Q23 through Q25. These three questions determine the likelihood that the respondent (or others for groundwater) would use the three different types of resources if the resources were not contaminated, and an increase in the sum of the responses to these questions would be expected to increase ADJWTP. A fourth index variable to gauge the respondent's motivation for wanting to clean up hazardous substances in the Clark Fork River Basin (MOTIVATION SUM = MS) was created by summing the

Table 5-17
Definitions of Independent Variables for Econometric Analysis

Variable	Definition	Expected Sign of Coefficient
SIS	Site Importance Sum: sum of responses to Q19 through Q22	(+)
IIS	Issue Importance Sum: sum of responses to Q3, Q7 and Q11	(+)
ULS	Use-Likelihood Sum: sum of responses to Q23 through Q25	(+)
MS	Motivation Sum: sum of responses to four parts of Q26	(+)
INCOME	Total household income in 1992 before taxes and deductions (Q44)	(+)
AGE	Present age (Q37)	(-)
GENDER	0,1 variable with: 0 = male respondent 1 = female respondent (Q38)	(?)
RECYCLE	0,1 variable with: 0 = respondent's household has not recycled in last month 1 = respondent's household has recycled in last month	(+)
RESPONSIBLE	Degree to which respondent feels responsible to help pay for cleanup at the Clark Fork River Basin (Q34)	(+)
NEAR	0,1 variable with: 0 = does not live in county containing or in a county adjacent to a county containing the Clark Fork River along which the NPL sites are located 1 = lives in county containing or in a county adjacent to a county containing the Clark Fork River along which the NPL sites are located (Q36)	(+)
CONTRIB	0,1 variable with: 0 = has contributed to no environmental organizations in past year 1 = has contributed to at least one environmental organization in past year (Q42)	(+)

responses to the four parts of Q26. This question asks the respondent to rate the following reasons for cleanup: use by family or yourself, use by others, use by future generations and existence value. An increase in the value of this variable is also expected to increase ADJWTP.[5]

Income is included as a proxy for education, profession and other correlated variables. If income was missing for a respondent, it was either predicted using a model with income as the dependent variable (see Section 5.1) or the sample mean income was used.[6] Age and gender have sometimes been correlated with variation in WTP in prior studies and are included here. Based on prior studies the expected sign of the coefficient on age is negative. The expected sign of the coefficient on gender is unknown. Also included are two variables (RECYCLE and RESPONSIBLE) indicating whether or not the respondent recycles (Q41) and how responsible the respondent feels he is to help pay for the cleanup of hazardous substances at the Clark Fork NPL sites (Q34), respectively. Another variable (NEAR) is included to investigate the effect of distance on ADJWTP. It should be noted, however, that use (ULS), importance measures (SIS, IIS), and distance are all positively correlated and, because of multicollinearity, not all of these variables may be statistically significant.[7] Finally, a shift variable (CONTRIB) is included, which takes into account whether the respondent has held membership or donated time or money to environmental organizations over the past year (Q42). The variable is included as a proxy for environmental awareness and concern.

[5] Our models were also estimated using the individual components of these four index variables as separate variables. This action led to only marginal changes in fit and severe multicollinearity, so the index variables were used. Also included were interaction variables, such as age-squared, age × income, gender × income, and ULS × distance; none of which was statistically significant.

[6] The natural log of income in thousands of dollars is used in all models discussed below to allow a nonlinear income-WTP relationship.

[7] NEAR equals one if the respondent lives in a county containing, or in a county adjacent to a county containing, the Clark Fork River along which the NPL sites are located. Otherwise, NEAR equals zero. The counties for which NEAR equals one are Beaverhead, Deer Lodge, Granite, Jefferson, Lake, Lewis and Clark, Madison, Mineral, Missoula, Powell, Ravalli, Sanders, and Silver Bow. Estimated distance (see Section 5.2) was also examined instead of NEAR, but it made virtually no difference in the analysis.

Model Specification

Non-Normality

A traditional regression model assumes that WTP measurement error is normally distributed. McClelland et al. (1991) suggest the measurement error for WTP may be lognormally distributed, which implies moderate and large WTP responses contain more error than lower bids. One method of analyzing this model is to assume a lognormal error distribution and transform the data by using *ln*(ADJWTP) as the dependent variable, where *ln* refers to the natural logarithm. In this approach, zero bids are still subject to evaluation for protest status using consistency checks, but large WTP bids are consistent with the error assumption and are not deleted via the consistency check approach. The contention that valuation errors are lognormally distributed has been supported by results from laboratory experiments, and econometric analysis has demonstrated the widely used Box-Cox transformation of the dependent variable is also consistent with a lognormal error distribution for values (Lazo et al., 1992).

In this transformation we assume all error in the regression is due to response measurement error in the reported WTP rather than to model specification error (i.e., we assume our functional form is correct, and there are no omitted variables). Under the assumption that the error distribution is lognormal, we predict the estimated mean adjusted WTP for each model after first normalizing the error. This will reduce the skew in the reporting error of respondents, and reduce the estimated mean adjusted WTP values. For each model we predict the *ln*(ADJWTP) value for each individual, which removes the estimated measurement error. Next, the ADJWTP is predicted from the predicted *ln*(ADJWTP) for each individual, and the mean is computed. This is the most conservative interpretation as it is likely that model specification error also exists and accounting for this could substantially increase the predicted values. If all error were due to model specification error and unobserved variations in preferences, this transformation procedure would not affect the mean WTP, and the mean WTP would exceed the mean computed with the lognormal model. Therefore, *this is a conservative procedure that provides a lower bound mean value estimate.*

Truncation

Due to the system of reporting bids and the psychology of respondents, it is likely that very low bids will be censored and reported as zeros. That is, respondents who wished to report $0.10, for example, had no number to circle on the payment card, and probably circled zero. Rather than arbitrarily assign a value to the zero bids of $0.10, for example, to retain the $0 bids in the log models (as the log of zero is undefined), a logical specification is to recognize that these bids are censored and fit a Tobit (limited dependent variable) model. Respondents for whom the observed level of ADJWTP is zero indicate that actual ADJWTP is not known, but is between zero and $1.00. The Tobit correction allows for a continuous distribution of WTP values greater than zero. Apart from the truncation, this would be a regression-type

model that would be more useful for data analysis than simple averages, as no prediction can be done, and more useful than log-linear regression without the Tobit correction, as an arbitrary assumption concerning the truncated observations implies the results are biased if the assumption is not correct.[8]

In this study, a regression-type lognormal error model with a Tobit correction was used to explain ADJWTP for each of the two survey versions and to predict ADJWTP responses.[9] Natural logs of ADJWTP for complete and partial cleanup were used as dependent variables. The results of these regressions along with predicted lognormal error corrected mean ADJWTP for each version are reported in Table 5-18 for complete cleanup and in Table 5-19 for partial cleanup.

Econometric Results

The models have a very good fit for cross-sectional data, explaining about 34 percent of the variation in complete and partial *ln*(ADJWTP) (see Tables 5-18 and 5-19).[10] Income, age, gender, proximity, responsibility rating, and the indices SIS and IIS are all statistically significant in all four models at the ten percent (one-tailed) level or better. The income coefficients represent income elasticities, which range from 0.438 to 0.670. Other variables such as MS, ULS, and RECYCLE are significant in some models, but not all — most likely reflecting multicollinearity. Note that the predicted coefficient on gender has a negative sign for all of the models. This result could reflect that men are more willing to pay for cleanup because they are more avid about hunting and fishing in impacted areas. The means of the error model ADJWTP results reported at the bottom of Tables 5-18 and 5-19 are about 60 percent of the consistency check sample ADJWTP responses reported in Tables 5-4 and 5-5. We reiterate that these model "predicted means" are estimates of the sample means that are downwardly biased and should be interpreted as lower bound value estimates.

[8] The Tobit correction is necessary because the natural logarithm of zero is undefined. Without the correction, an arbitrary assumption must be made to deal with the retained zero bids in the model. For comparison purposes, the data were modeled using a similar least squares lognormal regression without truncation (zero bids were set to $0.10). The results from the Tobit regression-type lognormal model and the lognormal regression model without the Tobit correction are very similar.

[9] Linear models were also estimated, but the log models resulted in a better fit.

[10] The goodness-of-fit statistics from the estimated least squares lognormal error models are reported. Since the percent of truncated observations is not large (about 12 percent), the indication of fit from these models is probably closer to a notion of fit than the various pseudo-R^2 measures suggested in the discrete choice econometric literature.

Table 5-18
Natural Log of Adjusted WTP Econometric Analysis Results for Complete Cleanup

Dependent Variable	Version 1 *ln*(ADJWTP)		Version 2 *ln*(ADJWTP)	
Constant	-4.233	(-4.058)***	-5.012	(-4.645)***
SIS	0.106	(3.078)***	0.144	(4.374)***
IIS	0.101	(1.996)**	0.080	(1.691)**
ULS	-0.004	(-0.108)	0.039	(1.125)
MS	0.029	(0.896)	-0.042	(-1.302)*
ln(INCOME/1,000)	0.438	(2.719)**	0.640	(3.506)***
AGE	-0.019	(-2.551)**	-0.010	(-1.270)*
GENDER	-0.721	(-2.910)**	-0.623	(-2.323)***
RECYCLE	0.415	(1.487)*	0.347	(0.993)
RESPONSIBLE	0.366	(4.728)***	0.440	(5.545)***
NEAR	0.442	(1.817)**	0.790	(3.055)***
CONTRIB	0.344	(1.218)	-0.045	(-0.140)
R^2	0.353		0.352	
NOBS	391		392	
Mean of predicted ADJWTP	25.02		31.36	

( ) = t statistics.

* Significance at the 10 percent level (one-tailed).
** Significance at the 5 percent level (one-tailed).
*** Significance at the 1 percent level (one-tailed).

Table 5-19
Natural Log of Adjusted WTP Econometric Analysis Results for Partial Cleanup

Dependent Variable	Version 1 *ln*(ADJWTP)		Version 2 *ln*(ADJWTP)	
Constant	-5.383	(-4.526)***	-4.802	(-4.558)***
SIS	0.083	(1.967)**	0.142	(4.433)***
IIS	0.123	(1.956)**	0.080	(1.735)**
ULS	-0.070	(-1.662)**	0.034	(0.990)
MS	0.021	(0.526)	-0.045	(-1.427)*
ln(INCOME/1,000)	0.670	(3.374)***	0.622	(3.492)***
AGE	-0.029	(-3.171)***	-0.010	(-1.310)*
GENDER	-0.486	(-1.596)*	-0.574	(-2.194)**
RECYCLE	0.416	(1.207)	0.344	(1.008)
RESPONSIBLE	0.631	(6.619)***	0.395	(5.097)***
NEAR	0.692	(2.317)***	0.739	(2.924)**
CONTRIB	0.356	(1.029)	-0.102	(-0.329)
R^2	0.309		0.331	
NOBS	391		392	
Mean of predicted ADJWTP	12.50		23.24	

( ) = t statistics.

* Significance at the 10 percent level (one-tailed).
** Significance at the 5 percent level (one-tailed).
*** Significance at the 1 percent level (one-tailed).

Variations in the inclusion and specification of variables in the model generally have only minor impacts on the results reported below. For example, variations including site familiarity (Q1), using alternative specifications of the OTHERPAY variable, and/or including or excluding one of the index variables (SIS, IIS), have only minor effects on the model fit and predicted WTP values.

In Section 5.1, we stated that most "high" bids (observations with raw WTP greater than one percent of income) are not identified as outliers by our lognormal models. An outlier is defined as an observation with a studentized residual (with the current observation deleted), which is equivalent to a t-statistic on an observation-specific dummy variable, greater than

1.645.[11] Linear models, with ADJWTP as the dependent variable and all important independent variables (and their squared terms) included, were employed to identify outliers. This approach leads to conservative damage estimates (i.e., a lower number of retained high bids) because the nature of the lognormal error assumption allows more large bids to be adequately explained by the independent variables (i.e., not identified as outliers) than the linear models (the log models "expect" more error for large bids and bids above the predicted mean, which is trimmed in the calculation of predicted values, than do the linear models).

All outliers identified by the linear models are high bids (removed before calculating sample statistics), but 68 percent of WTP responses in excess of one percent of income are not identified as outliers. This indicates most high bids relative to income are explained very adequately by other variables in the models. In fact, only two high bids are identified as outliers by the log models, indicating it may have been appropriate to include almost all of the 21 high bids that were removed prior to the reporting of sample mean WTP statistics. If these bids had been included, mean ADJWTP values reported in Tables 5-4 and 5-5 would have been approximately 46 percent higher. This indicates the ADJWTP sample statistics reported in Tables 5-4 and 5-5 are conservative estimates of true sample ADJWTP, while the predicted mean values from the log models are downwardly biased.

In Table 5-20, means of selected variables used in the econometric models are reported for various increments of the ratio of the unadjusted WTP (from Q28) to income (WTP/income = RATIO). These statistics provide further evidence that high bids (relative to income) are explained by variables in the models. RATIO increases with decreases in income, increases in responsibility rating (Q34), and increases in all of the attitudinal variables (SIS, IIS, ULS and MS).

5.4 ADJUSTING FOR BIASES IN WILLINGNESS TO PAY

Several survey design and implementation features have the potential to bias average WTP values. Bias can arise because of nonparticipation in the survey. If individuals who do not respond to the survey differ in a systematic manner from respondents, this could result in a bias in the valuation analyses. Sampling bias could also arise if the sample is fundamentally different from the population. We use econometric results from the previous section to measure the magnitude of these biases. Overall, the effects of these biases on sample WTP estimates are small. However, adjustments are made to account for both types of bias in the damage estimates reported in Chapter 6.0. Also addressed in this section is the bias caused by low self-assessed responsibility ratings in Q34. As demonstrated in Section 5.3, this

[11] Using 1.645 is conservative because it represents a 90 percent level of confidence for WTP response outlier identification. If a higher level of confidence had been used, more high bids would have been retained.

Table 5-20
Means of Six Variables Separated by Intervals of (WTP/Income)*

WTP/Income (RATIO)	Income (Q44)	Responsibility (Q34)	SIS (Q19-Q22)	IIS (Q3,Q7,Q11)	ULS (Q23-Q25)	MS (Q26)
≤ 0.01 N = 730	35,723	2.6	22	17	11	20
0.01 - 0.02** N = 37	23,311	3.1	24	19	13	21
0.02 - 0.03** N = 13	16,731	3.1	25	19	15	23
0.03 - 0.05** N = 11	21,818	3.5	26	19	14	23
> 0.05** N = 4	8,125	3.5	28	21	16	25

* See Table 5-17 for definitions of the variables.
** "High" bids. All high bids are included in this table.

variable is highly significant in determining ADJWTP in the econometric analysis. To the degree that respondents have a low willingness to accept responsibility for cleanup, WTP values are downwardly biased. We estimate how much values would increase if survey respondents who reject responsibility felt moderately responsible for helping to pay for cleanup at the Clark Fork Basin.

Estimated impacts from all three of these biases can be determined using the econometric results in Section 5.3, and adjustments to the analysis of total damages are made for these biases. To estimate the effect of nonresponse and sampling bias, the percent differences in predicted mean ADJWTP values for two groups being compared (e.g., respondents and nonrespondents who responded to the telephone survey) are calculated by inputting the differences between the mean values of the explanatory variables for the two groups into the log-linear regression model. These percent differences are then applied to the "best" ADJWTP results reported in Tables 5-4, 5-5, and 5-9. The calculation of responsibility scenario-rejection bias is discussed below. A summary of all biases, in percentage terms, is presented in Table 5-21.

Table 5-21
Correcting for Biases on WTP Values*

Type of Bias	To Correct for Bias Multiply Sample WTP Values by:			
	Version 1		Version 2	
	Complete	Partial	Complete	Partial
Sampling bias	97%	105%	93%	93%
Nonresponse bias	85%	83%	86%	86%
Scenario rejection bias: Unwillingness to accept responsibility	132%	142%	135%	134%
Combined corrections	110%	124%	107%	108%

* Percentage corrections are accurate to approximately ±5% (±2% for nonresponse bias).

Sampling Bias

As discussed in Section 3.2, the population is younger and has a smaller proportion of males than the sample. Referring to the results in Section 5.3, a decrease in age is accompanied by an increase in WTP, and a decrease in the proportion of males is accompanied by a decrease in WTP. Since the effects offset each other, the overall sampling bias is low. Using the econometric results from Section 5.3, values for the population are predicted to be, on average across the two survey versions, five percent lower for complete cleanup and one percent lower for partial cleanup.

Nonresponse Bias

The analysis in Section 5.3 is used to examine differences between respondents and nonrespondents to the mail survey. Those who did not respond to the mail survey were contacted by telephone after the first mailing of the survey (see Section 3.1). The purpose of the telephone follow-up was to encourage nonrespondents to complete the survey. Those who refused to return the survey were asked to answer a few questions over the phone to acquire partial information (see Table 3-5). Nonrespondents (i.e., telephone survey respondents) place slightly lower importance on the cleanup of hazardous waste sites (5.26 versus 5.82 on a scale from one to seven with one equal to "not at all important" and seven equal to "extremely important"). This may be due to fewer materials to consider (a shorter description and no map), the effect of which is discussed in Section 3.3, or because of less significance attached

to the issue by nonparticipants. The median age of nonrespondents is about 19 years older than for respondents (the difference between the means is only 13 years), and twice as many of the nonrespondents are female. Income of nonrespondents is, on average, about $10,000 per year less than income of respondents. The higher average income, lower average age, and higher proportion of males in the sample all tend to bias values upward as compared to nonrespondents. Using the econometric model, we predict that values for complete and partial cleanup for nonrespondents are, on average, 54 percent of the values for respondents. Since nonrespondents are about 32 percent of the adjusted sample, a conservative estimate of WTP values would include multiplying the values from the respondents by 85 percent {[(WTP × 68 percent of sample) + (54 percent × WTP × 32 percent of sample)] = 85 percent × WTP}.

Another type of nonresponse bias could be caused by the removal of respondents with protest zero bids and high bids. Using the econometric results from Section 5.3, we predict that mean ADJWTP for cleanup for respondents with protest zero bids is approximately 40 percent less than the sample mean ADJWTP, while the predicted mean for deleted high WTP responses is approximately 83 percent higher than the sample mean ADJWTP. Given that the protest zeros and high bids are such a small percentage of total respondents (8 percent), and given that the effects of deleted high and low WTP responses are offsetting, the impact of this source of bias is negligible.

Scenario Rejection Bias: Failure to Accept Implied Responsibility in WTP Questions

The WTP scenario estimates how respondents value cleanup by eliciting the amount of money the household would be willing to pay for cleanup. Respondents may partially or wholly reject the CVM scenario if, for example, they feel the polluter should pay. As a result, respondents may report a reduced WTP amount that only partially reveals their total value of cleanup. This introduces a downward bias into the analysis.

In Section 5.2, we discussed how a large portion of the respondents made comments indicating they felt they were not responsible to pay, and implying the polluter should pay. We also demonstrated how respondents who do not feel responsible to help pay (Q34) tend to choose payment mechanisms that put the payment burden on others. In Table 5-22, selected statistics are provided for those who accept responsibility and for those who do not accept responsibility.

Here, we define those who do not feel responsible as those who reported a 1 or 2 for Q34, and we define all others as willing to accept responsibility. Note that this definition is conservative, as those who reported a 3 in Q34 may have downwardly biased ADJWTP values due to partial scenario rejection as well. Those unwilling to accept responsibility are more likely to make protest comments, more likely to choose payment mechanisms that place the burden on others, have lower reported ADJWTP values, yet still place considerable importance on cleaning up hazardous waste sites as compared to the group willing to accept

Table 5-22
Reported Statistics for Those Who Do and Do Not Accept Responsibility to Pay for Cleanup (Q34)*

	Not Responsible (rating = 1-2)	Somewhat to Extremely Responsible (rating = 3-7)
Average responsibility rating	1.38 (N=420)	4.15 (N = 354)
Percent making protest comment	31.0% (N = 420)	19.2% (N = 354)
Percent placing payment burden on others (Q27)	27.4% (N = 420)	7.9% (N = 354)
Average importance level of hazardous waste sites (Q2)	5.47 (N = 419)	6.16 (N = 352)
Average $ADJWTP_C$	$28.38 (N = 417)	$65.91 (N = 354)
Income	$35,125 (N = 420)	$33,461 (N = 354)

* From one to seven with one = *not at all responsible* and seven = *extremely responsible.*

responsibility. All of this evidence, along with our econometric results, suggests that unwillingness to accept responsibility to participate in the payment for cleanup at the Clark Fork sites substantially biases the average WTP values downward.

Using the econometric results in the previous section, we estimated how much the average sample WTP response would increase if the *not responsible* group (i.e., responsibility rating equals 1 or 2) had the same average rating as the *responsible* group.[12] ADJWTP bids would increase by about 36 percent. This is a conservative correction, because if we defined the group with ratings of 3 as *not responsible*, the estimated bias would be even greater. Table 5-23 lists the frequency distribution of the responsibility rating and illustrates the extent of unwillingness to accept responsibility in our sample (omitting protest zeros and deleted large WTP responses). Almost 70 percent of the cleaned sample reports a low responsibility rating of 1, 2, or 3. Unwillingness to accept responsibility permeates the entire sample, and it is

[12] Each respondent with a responsibility rating of 1 or 2 was assigned a new rating of approximately 4.15, the mean of the remainder of the sample. New predicted means were calculated using the estimated coefficients from the lognormal error models discussed in the previous section, and responsibility bias was measured by comparing the new and old predicted means in percentage terms.

Table 5-23
Frequency Distributions of Responsibility Rating for Cleaned Data

Responsibility Rating*	Percent of Sample (N = 774)
1	33.3%
2	20.9%
3	15.0%
4	16.7%
5	8.1%
6	2.8%
7	3.0%

* From one to seven with one = *not at all responsible* and seven = *extremely responsible.*

likely our adjustment allows downward bias to remain. Consequently, our damage estimates reported in Chapter 6.0 are conservative.Aggregate complete, partial, and residual damages are presented in Chapter 6.0. These damage estimates are calculated using mean sample cleaned ADJWTP values from this chapter. Aggregate damages are adjusted for nonresponse bias, sampling bias, and unwillingness to accept responsibility.

5.5 SCOPE TESTING

5.5.1 Scope Tests

Among the concerns raised by the NOAA "Blue Ribbon Panel on Contingent Valuation" was that the values should be sensitive to scope: "Some form of internal consistency is the least we would need to feel some confidence that the verbal answers correspond to some reality" (58 *Fed. Reg.* 4601, 4604, 4609; Jan. 15, 1993). This issue arose, in part, from concerns that individuals might state the same willingness to pay for any resource change, or an arbitrary WTP for a resource change, which would lead one to question the reliability of the CVM results.

The concept underlying the issue of responsiveness to scope is that WTP values should vary in a manner that reflects differences in the quality, quantity, and importance of the good to the individual, and in a manner that reflects differences in characteristics of the individuals. As the quality, quantity, and importance of a good or service increases, WTP values should not decrease.

The NOAA proposed CVM regulations (50 *Fed. Reg.* 1062, January 7, 1994) and the DOI request for comments on CVM regulations (59 *Fed. Reg.* 23098, May 4, 1994) include specific between-sample statistical scope tests and request comments on within-sample scope tests. A between-sample scope test is a comparison of summary statistics (e.g., means or medians) from separate samples of respondents addressing separate resource changes (e.g., comparisons across different survey versions). A within-sample scope test is a comparison of results across individuals responding to the same survey version.

The appropriate form of any scope test on CVM study results is unresolved. For example, four of the six NOAA Blue Ribbon Panel members have commented that the NOAA proposed between-sample scope tests (and those listed for comment by DOI) misinterpret the NOAA panel statement that CV results should not be insensitive to scope (Arrow et al., 1994). Additionally, the U.S. EPA (1994) provides extensive comments that indicate that the NOAA and DOI scope tests have important limitations.

Scope is an important issue in the computation of residual damages in the Clark Fork CVM and can be used in the evaluation of the reliability of the Clark Fork CVM results. The Clark Fork study was specifically designed to:

1. Compute residual damages between partial and complete cleanup as the difference in values for complete and partial cleanup obtained from the same survey version (a within-sample difference), rather than from the difference in values across survey versions (a between-sample difference). As discussed in Section 5.5.2 and Appendix E, this approach to computing residual damages is more reliable.

2. Evaluate responsiveness to scope across individuals responding to the same survey version. As discussed in Section 5.5.3, the respondents to the CVM study demonstrate responsiveness to the scope of the injury.

5.5.2 Residual Damage Computations

The Clark Fork CVM study was specifically designed to compute residual damages between complete and partial cleanup using within-sample differences because the within sample difference will provide a more reliable residual damage estimate than will a between-sample difference. This design is consistent with well-established literature. Between-sample comparisons are statistically less powerful than within-sample comparisons (Erlebacher, 1977; Rosenthal and Rubin, 1980; and Keren, 1993 — see Appendix E and U.S. EPA, 1994 for additional detail). To reach similar levels of accuracy in examining differences between scenarios using between-sample testing requires substantially larger sample sizes than when using within-sample testing.

Difficulty in determining relative values as the difference in absolute values from between-sample testing is compounded in the CVM because absolute judgements are significantly more difficult to make, and hence less precise, than are relative judgements (Baird and Noma, 1979). For example, WTP for NRDA site cleanup might be accurate to within a range of about -25 percent to + 25 percent (e.g., a $50 reported value may reflect a true WTP between $35 and $65, which is consistent with the design of the payment card). In this case, statistically detecting a value difference of $15 is very difficult with independent samples addressing independent scenarios. However, the same respondents may, when presented with both scenarios in succession, readily assess that one is worth on the order of 25 to 35 percent less than the other (which is consistent with the design of Q33 to scale complete WTP to partial WTP).

The following example illustrates these issues. Consider two trees across the street of similar but unequal heights. One sample of individuals is asked to report the height of Tree A in 10 (or 20) foot increments, and a second sample of individuals is asked to report the height of Tree B in 10 (or 20) foot increments. The average of the estimates for both samples may well be the same or very similar, leading to the estimate of the difference in height of the two trees of positive, zero, or even negative value. Yet, if individuals are asked to estimate the difference in heights of the trees when examining both trees together, most individuals will clearly and correctly identify one tree as taller. They can also provide an estimate of how much taller the tree is, and that estimate will generally be much better than the estimate produced using a between-sample difference in results. This example exactly parallels measuring values for environmental cleanup at the Clark Fork sites as conducted in this study and illustrates why the within-sample comparisons in this study are more reliable.

5.5.3 The Clark Fork CVM Respondents are Sensitive to the Scope of Injury

Within-Sample Comparisons Demonstrate Sensitivity to Scope

Respondents to both survey versions demonstrate that complete cleanup is valued more than partial cleanup (see Tables 5-4 and 5-5). Both WTP and ADJWTP for complete cleanup are statistically significantly higher than for partial cleanup. These results demonstrate that respondents are sensitive to the scope of the injury.

Indirect Scope Tests Demonstrate Sensitivity to Scope

Indirect scope tests examine whether responses vary across individuals in a manner that reflects differences in characteristics of the individuals, and differences in how the individuals view the resource improvements. For example, NOAA identified "indirect tests" as tests "... to explain variation in WTP as a function of independent variables, including belief in the size of the damage scenario, and/or effectiveness of the avoidance policy. .... An indirect test examines the sensitivity to scope indirectly through the use of a WTP valuation function, relying entirely on the base instrument." (page 1146 columns 1 and 2).

Evidence reported earlier in Chapter 5.0 demonstrates that the WTP values reported by respondents to the Clark Fork CVM survey vary in the expected manner with the characteristics of the individuals and with differences in how the individuals view the resource improvements. Further, there is a high degree of statistical power in explaining differences in reported WTP values across individuals. For example:

- The results vary across individuals in a manner that reflects how the characteristics of the individuals would be expected to affect values. For example, WTP increases with income, decrease with age, and decreases with self-perceived responsibility to pay for site cleanup (Tables 5-18 and 5-19).

- WTP values for complete cleanup in Version 1, and again for partial cleanup in Version 2, vary across individuals in a manner consistent with the differences in the importance of site cleanup to the individual (SIS and IIS scores), and differences in expected proximity and use of the site by the individual (NEAR and ULS variables, see Tables 5-18 and 5-19). These differences in value across individuals reflect independent comparisons of value for changes in the expected quality and quantity of the good as viewed by the respondents. These comparisons confirm that individuals who expect to receive increased levels of services from the cleanup of the Clark Fork NPL sites report increased WTP values.

- Across-individual regression analyses indicate that WTP for complete cleanup is highly correlated with the satisfaction scores the individual assigns to complete cleanup (Table 4-3). Based on the difference between satisfaction scores for complete cleanup and for partial cleanup (Table 4-3), one would predict a significant reduction in WTP for partial cleanup, which is consistent with the reported partial cleanup WTP values in survey Version 1 and in survey Version 2. This again confirms that across individuals and across cleanup scenarios, WTP varies across individuals in a manner that is consistent with perceived differences in the scope and satisfaction with the cleanup.

The Clark Fork CVM was not Designed for Between-Sample Comparisons

As discussed above, the Clark Fork CVM study was designed for within-sample comparisons to compute residual damages:

- The Montana CVM partial and complete cleanup scenarios are too similar to apply between-sample statistical scope tests. For example, 41 percent of respondents value the two scenarios equally when directly comparing the scenarios, and 44 percent rank the two scenarios as providing approximately the same satisfaction. From the within-sample comparisons, across all individuals, partial cleanup is valued at about 65 to 74 percent of complete

cleanup (Tables 5-4, 5-5, 6-1). Large scenario differences would be a more appropriate basis for between-sample scope testing, which is what NOAA/DOI recommend be developed in pretesting. The Clark Fork scenarios, which are similar, provide a good example of why the NOAA/DOI between-sample statistical scope tests have limitations as to when they should be applied.

- The payment cards and WTP adjustment scales between complete and partial cleanup (Q33 in Version 1) were specifically designed for within-sample comparisons to compute reliable partial cleanup values and residual damages (Section 5.5.2). The payment card increments, typically on the order of about 50 percent, were not designed to support between-sample statistical scope tests of scenario differences that are 25 to 35 percent different in value. Rather, the 10 percent increments in the adjustment scale (Q33 in Version 1) are designed to compute differences in values across scenarios more precisely.

Between-Sample Comparisons Demonstrate Sensitivity to Scope

Although the Clark Fork CVM was not designed for between-sample comparisons, the survey results pass a between-sample scope test when following NOAA guidance on eliminating individuals who are likely to be insensitive to differences in scenarios.

In developing its proposed scope tests, NOAA recognizes that certain individuals may have difficulty answering CVM questions and may therefore provide inaccurate responses or responses that are insensitive to the scope of the environmental insult. The regulations suggest that these individuals be identified and that the scope test be conducted with the remaining participants.

> The issue is complicated by the possibility...that a significant minority of the population may be insensitive to any reasonable differences in scenarios: some individuals may not be willing to pay anything for any environmental cleanup, other may be willing to pay unrealistically high (and invariant) amounts for any size environmental cleanup. The trustees are to develop procedures for identifying these people, so that the demonstration that the scenarios are meaningfully different would rest on the remaining participants. ... NOAA is seeking comments on ... how should "insensitive" individuals be excluded? (page 1146 column 1).

In our analysis of the Clark Fork CVM results (Section 5.2), we used a very conservative procedure to delete respondents from statistical analysis. This procedure results in reduced mean WTP values. By systematically identifying and deleting respondents who report the most difficulty with embedding, in this section we demonstrate that between-sample results for the remaining respondents pass the scope test.

Previous studies (Chestnut and Rowe, 1990a; and Rowe et al., 1992) have included questions about respondents' embedding (such as Q30/Q31 in the Clark Fork CVM) and about respondents' self-reported accuracy using a scale of "very accurate," "within the ballpark," "somewhat inaccurate," and "probably very inaccurate." These studies find that there is a strong correlation between increased embedding (Q30) and reduced self-reported accuracy. Also, individuals reporting difficulty with embedding and with accuracy were more likely to provide the same WTP value for different scenarios and to report other problems. In the Montana survey, for example, respondents reporting "4 Other," or having missing responses for Question 30, are 3 times more likely to choose payment vehicles that require others to pay for the cleanup, and they report significantly lower (36 percent lower) responsibility scores.

Therefore, individuals who report on Q30 that their values are "1 Just for the cleanup at the Clark Fork River Basin" or "2 Partly for Cleanup at the Clark Fork River Basin..." are likely to provide more accurate and reliable WTP values than are those individuals who respond to Q30 that their reported WTP is "3 Basically a contribution for all environmental or other causes," "4 Other," or have a missing response. WTP responses from individuals who report responses of 4 or missing to Q30 should be weighted less heavily than, for example, individuals reporting the first two embedding responses.

Table 5-24 presents a between-sample scope-test eliminating only those individuals who said their WTP values were for "4 Other," or individuals for whom the response to Q30 was missing. This comparison retains over 82 percent of the sample with cleaned WTP data (after protest zeros and selected high bids are removed). The mean WTP values are larger than for the entire sample with cleaned data. The mean and median values for complete cleanup from survey Version 1 are larger than the corresponding values for partial cleanup from survey Version 2. The percentage differences are smaller than the within-sample differences, but still reflect them; they are significant at $\alpha = 0.11$ using a one-tailed test.

This comparison can be conducted with progressively smaller subgroups of respondents who can be expected to have more and more reliable responses: (a) those who report Q30 = 1,2,3; (b) those who report Q30 = 1,2; and (c) those who report Q30 = 1. These comparisons reflect a pattern of increasing WTP values, and increasing numerical and statistical differences between the WTP for complete cleanup in Version 1 and for partial cleanup in Version 2.

Table 5-24 clearly indicates that, although the survey was not designed to be evaluated with a between-sample scope test, the majority of respondents do show both within-sample and between-sample responsiveness to scope in a manner consistent with economic expectations and consistent with other results provided in the survey. Further, if the analysis were based strictly on those individuals who are likely to have the most reliable WTP responses for cleanup of the Clark Fork NPL sites, the WTP values would be larger than those used throughout this report.

Table 5-24
Between-Sample Scope Test Based on Q30 Responses
(for respondents with Q30 = 1,2,3)

(1) Variable	ADJWTP Values			
	(2) Complete Cleanup (Version 1)	(3) Partial Cleanup (Version 2)	(4) $ Difference	(5) % Difference
# observations, % of WTP sample	N=315, 82%	N = 329, 85%		
Simple mean (SE of mean)	$46.43 (3.04)	$41.03 (3.04)	$5.40 (4.30)	11.6%
Simple median	$25	$18	$7	28%

6.0 SUMMARY OF INDIVIDUAL AND AGGREGATE VALUE MEASURES

6.1 HOUSEHOLD ANNUAL VALUE ESTIMATES

The "best" estimates of the average individual ADJWTP values are the estimates cleaned of protest zeros and uncertain high WTP responses (Tables 5-4, 5-5, and 5-9) and adjusted for embedding (ADJWTP as opposed to WTP), potential sampling bias, nonresponse bias, and responsibility bias (Table 5-21). These values for complete cleanup, partial cleanup, and residual damages after partial cleanup are reported in Table 6-1. Household annual ADJWTP sample estimates for complete cleanup adjusted for potential biases range between $44 and $54. Household annual ADJWTP estimates for partial cleanup adjusted for bias range between $32 and $40.

Residual damages are the measure of damages if nothing further is done beyond the partial cleanup scenario. Residual damages are calculated by subtracting ADJWTP for partial cleanup from ADJWTP for complete cleanup for respondents to Survey Version 1 and Survey Version 2 separately. Residual damages, adjusted for potential biases, range between $12 and $14. Residual damages are statistically significantly different from zero at a probability level of 95 percent or better.

Table 6-1
Summary of Best Household ADJWTP Values*
($ 1993 annual WTP/household per year for 10 years)

	Version 1	Version 2	Average of Version 1 and Version 2
Values for complete cleanup	$44	$54	$49
Values for partial cleanup	$32	$40	$36
Residual damages if partial cleanup is undertaken	$12	$14	$13

* Rounded to nearest dollar. These values are corrected for sampling bias, nonresponse bias, and scenario rejection bias (see Table 5-21).

6.2 AGGREGATE VALUE ESTIMATES

The WTP question elicits the maximum WTP for cleanup to be paid every year for ten years for a cleanup that takes many years to complete. The present value of the stream of ADJWTP payments over ten years is discounted by seven percent each year, the real discount rate provided by the regulations ([43 CFR § 11.84 (e)(2)] and Office of Management and Budget, 1992). This results in a multiplication factor of 7.515 times the annual WTP amount. The present value for the stream of ADJWTP payments is then multiplied by the total number of residents in Montana divided by the average number of people in a household to calculate estimates of aggregate ADJWTP for cleanup of the four Clark Fork NPL sites for all households in Montana. The U.S. Census Bureau estimated there were approximately 824,000 residents in 1992. The current average household size is 2.53. This results in a multiplication factor of 325,692 (824,000/2.53). Aggregate discounted ADJWTP estimates (i.e., present and future damages) for cleanup are reported in Table 6-2. The base year for all present value calculations is 1993.

Table 6-2
Present and Future Aggregate Value Estimates for Natural Resource Injuries at the Clark Fork NPL Sites*
(millions of $ 1993, present value 1993)

	Version 1	Version 2	Average of Version 1 and Version 2
Total present and future value for complete cleanup	$107	$133	$120
Total present and future value for partial cleanup	$78	$98	$88
Residual damages if partial cleanup is undertaken	$29	$35	$32

* Rounded to nearest million. These values are corrected for sampling bias, nonresponse bias, and scenario rejection (see Table 5-21). These estimates exclude values to individuals outside of Montana.

This report also allocates WTP to the three resource groups. In Table 5-10, WTP is assigned to cleanup of three resource groups, and to "other impacts." As identified in Table 5-10, many of the reasons cited for "other impacts," which is only 6 percent of the total, are tied to, clarify, or reinforce cleanup of the three resource groups. Therefore, the share of damages assigned to "other impacts" is reassigned to the three resource groups in proportion to the damages assigned to each of the three groups. Present and future aggregate damages by natural resource group are summarized in Table 6-3.

Table 6-3
Total Present and Future Aggregate Values for Complete Cleanup by Natural Resource Group* (millions of $ 1993, present value 1993)

	Version 1	Version 2	Average of Version 1 and Version 2
Aquatic resources and riparian habitat injuries	$38	$47	$43
Groundwater injuries	$35	$45	$40
Upland soil, vegetation, wildlife, and wildlife habitat injuries	$34	$41	$37
Total	$107	$133	$120

* Rounded to nearest million. These values are corrected for sampling bias, nonresponse bias, and scenario rejection (see Table 5-21). These estimates exclude values to individuals outside of Montana.

6.3 CONSERVATIVE VALUE ESTIMATES

Several features of the survey design, study sample, and analysis lead to the interpretation that the value estimates provided are conservative (low) estimates of values for cleanup of natural resource injuries at the Clark Fork NPL sites. These features include:

- We do not include nonresidents in the analysis, many who live closer to the Clark Fork Basin than do many Montana residents. If the WTP of nonresidents were included, aggregate values might increase many times (see Section 5.2).
- The value measures for complete and partial cleanup do not quantify interim damages that will occur during cleanup activities. Interim damages will be significant because of the length of time it will take to finish cleanup activities.
- Bias due to low levels of willingness to accept responsibility to help pay for cleanup is treated conservatively. It is likely residual responsibility bias remains, which biases values downward.

As a result of these and other features of the survey design and analysis it is likely that actual values, and therefore damages, are larger than are reported here.

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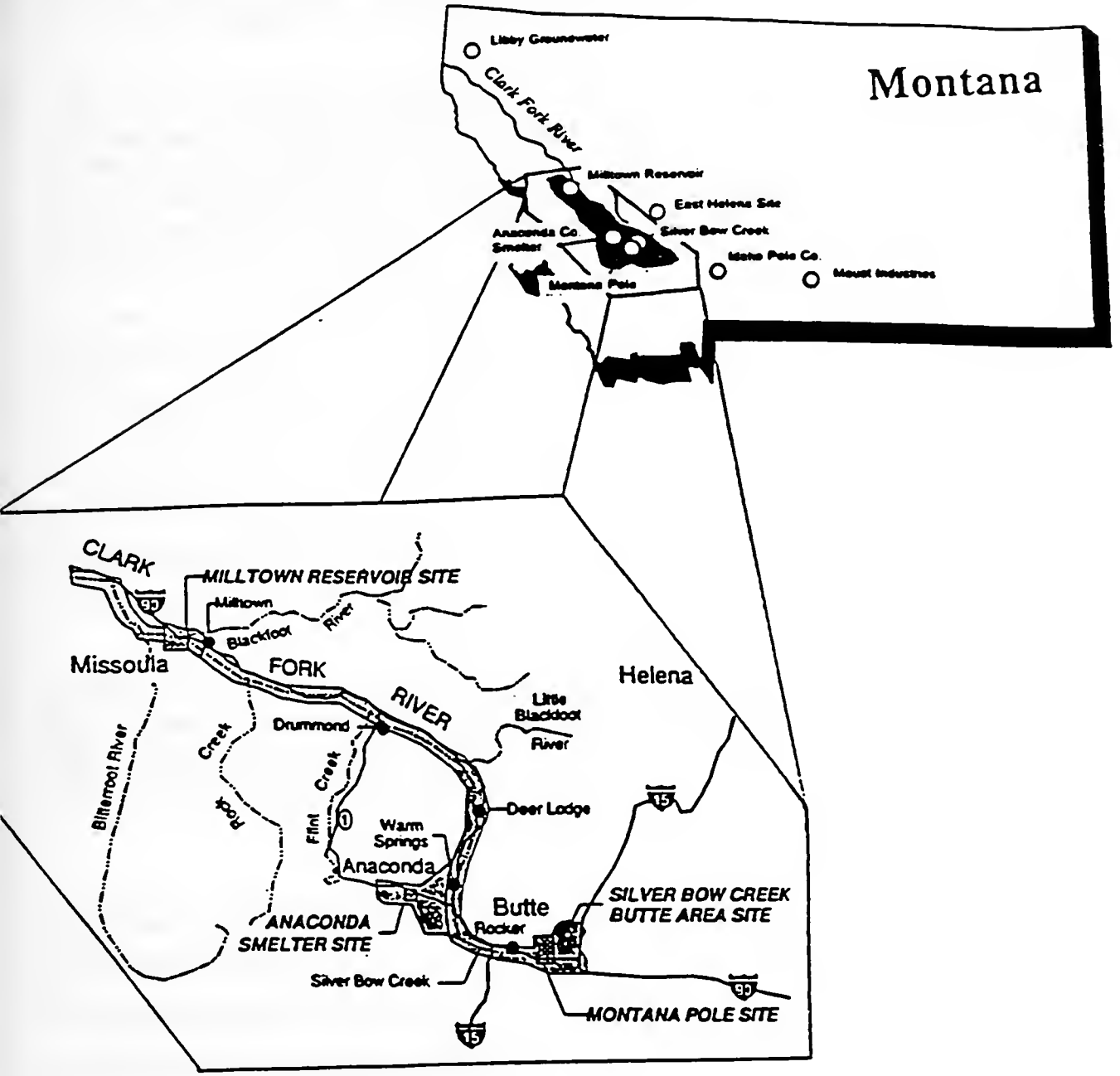
APPENDIX A
SURVEY INSTRUMENTS

- Mail Survey — Version 1
- Mail Survey — Version 2
- Mail Survey — Color Insert
- Mail Survey — Cover Letter for First Mailing
- Mail Survey — Follow-Up Postcard
- Telephone Follow-Up Survey — Instructions and Questionnaire
- Mail Survey — Cover Letters for Second Mailing

Cleaning Up Hazardous Wastes in Montana
The Clark Fork River Basin: What is Your Opinion?



Research Conducted by RCG/Hagler, Bailly, Inc.

Please return survey to:
RCG/Hagler, Bailly, Inc.
P.O. Box 1885
Great Falls, MT 59403-9833
1-800-568-0974

Version 1

INTRODUCTION

While providing jobs and producing goods and services used by everyone, many Montana industries also produce hazardous substances in their wastes. These hazardous substances can harm water, land, plants, and animals, and may reduce people's opportunities to enjoy Montana's natural resources for recreation and other uses.

Q1 There are over 250 sites in Montana where hazardous substances may be present. Some sites are old and abandoned, and some are still being used. Eight sites have been put on the U.S. Environmental Protection Agency's National Priorities List (NPL) for cleanup and are called Superfund sites. The eight NPL sites are identified on the map on the cover of this questionnaire. Have you seen, heard, or read about the NPL sites listed below? (Circle NO or YES for <u>each</u> site.)

SILVER BOW CREEK/BUTTE AREA SITE	NO	YES
MONTANA POLE SITE	NO	YES
ANACONDA SMELTER SITE	NO	YES
MILLTOWN RESERVOIR/CLARK FORK RIVER SITE	NO	YES
EAST HELENA SITE	NO	YES
IDAHO POLE COMPANY SITE	NO	YES
MOUAT INDUSTRIES SITE	NO	YES
LIBBY GROUNDWATER SITE	NO	YES

Q2 Policy makers need to understand how important it is to you to clean up hazardous waste sites compared to other issues also facing the citizens of Montana. From not at all important to extremely important, how would you rate each of the issues listed below? (Circle number of best response for each issue.)

	NOT AT ALL IMPORTANT ▼						EXTREMELY IMPORTANT ▼
IMPROVING THE EDUCATION SYSTEM	1	2	3	4	5	6	7
REDUCING AIR POLLUTION	1	2	3	4	5	6	7
BRINGING NEW JOBS TO THE STATE	1	2	3	4	5	6	7
IMPROVING PUBLIC ROADS AND HIGHWAYS	1	2	3	4	5	6	7
PRESERVING WILDERNESS AREAS	1	2	3	4	5	6	7
PROMOTING RECYCLING	1	2	3	4	5	6	7
CLEANING UP HAZARDOUS SUBSTANCES AT SITES	1	2	3	4	5	6	7

IMPACTS AND CLEANUP OF HAZARDOUS SUBSTANCES

This section discusses how hazardous substances from mining and other industries can harm natural resources and describes different methods that can be implemented to clean up these hazardous substances. Note that cleaning up the hazardous substances at sites will not return the environment to completely "natural" conditions. Impacts from agriculture, highways, and other human causes will not be cleaned up; sites will only be restored to conditions that would have existed if the hazardous substances had not been released. **(Please unfold the color insert enclosed with the survey and look at Figures 1, 2, and 3.)**

Contamination and Cleanup of Surface Water

Surface water (streams, lakes, and ponds) provides habitat for fish, insects, birds, and other animals, and supports recreational activities such as swimming, fishing, and boating.

When water flows through contaminated soils, floodplain sediments, or industrial waste piles (such as a tailings pile made up of mining and milling wastes), it can pick up contaminants and carry them into streams and rivers **(A, B, and C in Figure 1 on insert)**. Surface water contaminated with industrial and mining wastes can affect fish, groundwater, and streamside plants. Hazardous substances in high concentrations may be toxic to living organisms.

Q3 How important would you say that surface water contamination issues in Montana are to you? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

We would like you to consider several cleanup options for surface water: complete cleanup, partial cleanup, and an alternative option.

Q4 **Complete Cleanup of Surface Water.** Sources of contamination would be removed. For example, mine tailings and contaminated streambed sediments would be removed and placed in a landfill. Water quality would return to conditions that would have existed without contamination, and fish populations would return to normal levels. New soil would be placed along streambanks, and streamside trees, shrubs, and grasses would be planted to provide natural wildlife habitat. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY SATISFIED

Q5 **Partial Cleanup of Surface Water.** Contaminated materials along streambanks would be pulled back from the water's edge and streambanks would be planted with grasses. Water quality would improve, but rainstorms and snowmelt occasionally would flush contamination into the river causing poor water quality. The number of fish would increase, but would remain below normal levels because of contamination in streambed sediments. Shrubs and trees typical of the area would not be planted, and habitat for some species of wildlife would be permanently lost. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Q6 **Alternative Option.** Contaminated areas would not be cleaned up. However, uncontaminated stream or riverside lands with in-stream water rights, wildlife habitat, and fishing or other recreational access similar to the impacted area before it was contaminated could be purchased by the State. These lands would be held in trust by the State to ensure that their natural resources remain protected in the future. How satisfied would you be with this alternative option? (Circle number of best answer.)

NOT AT ALL SATISFIED						EXTREMELY SATISFIED
1	2	3	4	5	6	7

Contamination and Cleanup of Groundwater

Groundwater exists below ground, usually in small spaces in rocks or sediment. Groundwater flows much more slowly than surface water, often no more than a few feet to a few hundred feet a year. The direction in which groundwater flows depends on gravity and the type of material that holds the water **(see B in Figure 2 on insert)**. When surface water (streamflow, runoff, or rainfall) seeps through soil containing hazardous substances, hazardous substances in the soil will be dissolved into the groundwater **(see A in Figure 2)**. Movement of contaminated groundwater can cause contamination to spread over a larger area. Until the sources of hazardous substances are removed or are isolated from groundwater, contamination can continue to spread.

Q7 How important would you say that groundwater contamination issues in Montana are to you? (Circle number of best answer.)

NOT AT ALL IMPORTANT						EXTREMELY IMPORTANT
1	2	3	4	5	6	7

We would like you to consider several cleanup options for groundwater:

Q8 **Complete Cleanup of Groundwater.** Sources of contamination would be isolated from groundwater or, at small sites, removed. Underground barriers would be built to limit the spread of contamination into clean groundwater. Contaminated groundwater would be pumped up to the surface and treated. The clean water would be reinjected underground. About the same amount of clean water would be available as before the contamination occurred. How satisfied would you be with this option? (Circle best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q9 **Partial Cleanup of Groundwater.** Groundwater would remain contaminated. At small sites, sources of contamination would be either removed or isolated to limit further contamination. Use of the groundwater in contaminated areas would be prohibited. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q10 **Alternative Option.** Contaminated groundwater would not be cleaned up, nor would it be contained. However, water rights could be purchased to provide clean groundwater to replace the amount lost because of contamination. How satisfied would you be with this alternative option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Contamination and Cleanup of Air, Soil, Vegetation, and Wildlife

Soils can become contaminated by smoke stack emissions **(A in Figure 3 on insert)**, or when contaminated material is blown onto nearby uncontaminated soils **(B)**. Rain and snow falling through the air pick up particles and "wash" them onto soils and water below **(C)**. Runoff from contaminated soils can contaminate surface water **(Figure 1)** and groundwater **(Figure 2)**. Hazardous substances in soils can cause toxic reactions in plants such as wilting, stunted growth, and death. The reduction or elimination of vegetation can affect the ability of the environment to provide habitat for wildlife that rely on plants for food or protection, although animals may be seen passing through impacted areas.

Q11 How important would you say air, soil, vegetation, and wildlife contamination issues in Montana are to you? (Circle number of best answer.)

NOT AT ALL IMPORTANT — EXTREMELY IMPORTANT

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

We would like you to consider several cleanup options for soil, vegetation, and wildlife:

Q12 **Complete Cleanup of Soil, Vegetation, and Wildlife.** The most highly contaminated soils would be removed and put in a landfill. In less contaminated areas, a top layer of uncontaminated soil would be added. The entire area would then be replanted with native grasses, trees, and shrubs. The area would provide similar vegetation and approximately the same amount of habitat for wildlife as would have been available before contamination occurred. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY SATISFIED

Q13 **Partial Cleanup of Soil, Vegetation, and Wildlife.** The most contaminated soils and waste deposits would be removed and placed in a landfill. These areas would be replanted with grasses and some trees. Wildlife habitat would not be fully restored and would be permanently lost over the majority of the contaminated area. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY SATISFIED

Q14 **Alternative Option.** Contaminated areas would not be cleaned up. However, land that would provide soil, vegetation, wildlife habitat, and recreational access similar to the impacted area before it was contaminated could be purchased by the State. These lands would be held in trust by the State to ensure that their natural resources are preserved in the future. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY SATISFIED

ABOUT MONTANA'S NPL SITES

Montana currently has eight hazardous waste sites on the U.S. Environmental Protection Agency's National Priority List (NPL) **(see cover)**. Four of these sites are described below.

Q15 The East Helena Site. For over 100 years, lead and zinc smelting operations have released contaminants around the city of East Helena. Surface soils and groundwater located in an eight and a half-square mile area of residential and rural agricultural land around the smelter contain hazardous substances. How important to you is it to clean up hazardous substances at the East Helena Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q16 The Idaho Pole Company Site is a 50-acre wood treatment facility located in Bozeman. Past spills and disposal practices resulted in the contamination of soil, groundwater, and surface water on site. How important to you is it to clean up hazardous substances at the Idaho Pole Company Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q17 The Mouat Industries Site is located in Columbus. In the late 1950s and early 1960s ore processing produced wastes containing chromium, a hazardous substance. At this two-acre site, both groundwater and soils are contaminated. A plant is being constructed to treat soils. How important to you is it to clean up hazardous substances at the Mouat Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q18 The Libby Groundwater Contamination Site is located in Libby. For 23 years, wood treating fluids were disposed of and spilled at several different locations on the mill property. In 1979, the Environmental Protection Agency found the soil and groundwater at the site to be contaminated. Groundwater contamination extends into the city of Libby. Residents have been provided with an alternate water supply and treatment of contaminated soil is taking place. However, groundwater at the site is likely to remain contaminated for decades or more. How important to you is it to clean up hazardous substances at the Libby Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

ABOUT THE CLARK FORK NATIONAL PRIORITY LIST SITES

The remaining four NPL sites are located in the Clark Fork River basin from Butte to Milltown, an area with about 60,000 people (see Map A on Insert). Impacts at the sites have largely resulted from releases of hazardous substances from historic mining activities. These historical activities were subject to less stringent regulations than are applicable today. *[Note that an acre is about 4/5ths the size of a football field. An acre-foot of water is the amount of water needed to cover an acre to a depth of one foot; this is about the amount of water that two typical Montana households use in a year.]*

Q19 The Silver Bow Creek and Butte Area Site includes the Butte area, the Berkeley Pit, 24 miles of Silver Bow Creek, and the Warm Springs Ponds **(Map A)**. The Berkeley Pit was excavated to mine ore in Butte. It now contains approximately 50,000 acre-feet of contaminated water.

The Warm Springs Ponds were built to reduce the flow of hazardous substances into the Clark Fork River by settling them out of Silver Bow Creek. The ponds now contain roughly 15 million cubic yards of contaminated sediments. Mining and milling operations have contaminated groundwater throughout a large portion of the Butte area. Silver Bow Creek can no longer support fish because of surface water contamination, and wildlife such as otter that rely on fish for food cannot use the area.

About 750 acres of soils along Silver Bow Creek have been contaminated to the extent that little streamside vegetation, such as willow shrubs and cottonwood trees, can survive. This has caused wildlife habitat to be lost for species such as white-tailed deer, great blue heron, common songbirds such as flycatchers and sparrows, and birds of prey such as red-tailed hawks. How important to you is it to clean up hazardous substances at the Silver Bow Creek and Butte Area Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q20 The Montana Pole Site is a former wood treating facility located in west Butte adjacent to Silver Bow Creek and Interstate Highway 90 (I-90) **(Map A)**. From 1946 to 1983, the facility was used to preserve utility poles, posts, and bridge timbers with the hazardous substance pentachlorophenol (PCP). Approximately 20 acres of soils and about 200 acre-feet of groundwater have been contaminated. How important to you is it to clean up hazardous substances at the Montana Pole Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q21 The Anaconda Smelter Site is near the town of Anaconda **(Map A)**. Smelting operations at the site continued from 1884 through 1980 and hazardous substances were released as tailings, flue dust, and stack emissions. For example, in the mid-1970s the smelter released about five tons of copper and six tons of arsenic into the air each day contaminating soils. This has harmed vegetation such as grasses, willow shrubs, and Douglas-fir and lodgepole pine trees. Because of this, wildlife habitat has been lost over about a 15-square mile area for species such as elk, pine marten, blue grouse, and various common songbirds such as warblers, bluebirds, and thrushes. How important to you is it to clean up hazardous substances at the Anaconda Smelter Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q22 The Milltown Reservoir/Clark Fork River Site includes 120 miles of the Clark Fork River between Warm Springs Ponds and the Milltown Reservoir (**Map A**). Along this stretch of the Clark Fork River, surface water and streambed sediments have been contaminated with hazardous substances from mining, milling, and smelting. Because of the toxic effects of this contamination, trout populations have been reduced to, on average, about one-quarter of what they could be without contamination.

About 250 acres of soils along the upper Clark Fork River have been contaminated to the extent that little streamside vegetation, such as willow shrubs and cottonwood trees, can survive. This has caused wildlife habitat to be lost for species such as white-tailed deer, great blue heron, common songbirds such as flycatchers and sparrows, and birds of prey such as red-tailed hawks. Contaminated sediments from the Clark Fork River have been trapped in the reservoir behind the Milltown dam and have contaminated groundwater in the area. How important to you is it to clean up hazardous substances at the Milltown Reservoir/Clark Fork River Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT						EXTREMELY IMPORTANT
1	2	3	4	5	6	7

NATURAL RESOURCE IMPACTS AT THE CLARK FORK NPL SITES

This section discusses current natural resource impacts in the Clark Fork River basin caused by historic and continuing releases of hazardous substances.

Surface Water Resources (See Photos 1, 2, and 3 on Insert)

Currently, because of contamination of surface water, all trout, as well as virtually all other fish, have been eliminated from Silver Bow Creek. Wildlife that rely on fish for food, such as otter, cannot use the area. In 120 miles of the Clark Fork River between Warm Springs Ponds and Milltown, the number of trout present in the river has been reduced to, on average, about one-quarter of what could be there if contamination were not present. Otter are also not found here.

Contamination of streambanks along Silver Bow Creek and the upper 17 miles of the Clark Fork River between Warm Springs Ponds and Deer Lodge has resulted in the virtual elimination of streamside vegetation such as grasses, willow shrubs, and cottonwood trees on approximately 750 acres of Silver Bow Creek and 250 acres of the Clark Fork River. Because of this, wildlife habitat for many species such as white-tailed deer, great blue heron, birds of prey such as red-tailed hawks, and various common songbirds such as flycatchers and sparrows has been eliminated in these stretches.

Q23 How likely is it that you would use these areas along the Silver Bow Creek and Clark Fork River if they were not affected by hazardous substances? (Circle number of best answer.)

NOT AT ALL LIKELY						EXTREMELY LIKELY
1	2	3	4	5	6	7

Groundwater Resources

Currently, roughly 800,000 acre-feet of groundwater at several sites in the Clark Fork River basin have been contaminated so that it cannot be used for drinking without treatment.

In the Silver Bow Creek and Butte Hill Area, about 500,000 acre-feet of groundwater have been contaminated. The city's current water needs have been met by a water diversion provided by industry.

Near the Warm Springs Ponds and the town of Anaconda, about 300,000 acre-feet of groundwater have been contaminated, mostly under land currently owned by industry. About 5,000 acre-feet of groundwater previously used by residents of the town of Milltown have been contaminated. Industry and the U.S. Environmental Protection Agency have moved the town's wells to clean areas in the same groundwater aquifer. Use of wells in the contaminated area is not permitted.

Q24 How likely do you think it is that contaminated groundwater in the Clark Fork River basin will be needed for future use? (Circle number of best answer.)

NOT AT ALL LIKELY — EXTREMELY LIKELY

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Air, Soil, Vegetation, and Wildlife Resources (See Photos 4, 5, and 6 on Insert)

Currently, hazardous substances in smelter emissions have contaminated soils causing severe impacts to trees such as Douglas-fir and lodgepole pine, shrubs such as willows, and various grasses over an approximately 9,600-acre area (about 15 square miles) near Anaconda that includes Smelter Hill, portions of Mt. Haggin, and Stucky Ridge. This has caused habitat to be lost in this area for wildlife species including elk, pine marten, blue grouse, birds of prey such as red-tailed hawks, and common songbirds such as bluebirds, thrushes, and warblers.

Mining wastes containing hazardous substances were disposed of on about five square miles in the Opportunity Tailings Ponds area between Anaconda and Warm Springs Ponds. This has caused the elimination of vegetation such as grasses and willow shrubs. Wildlife habitat for species such as white-tailed deer and various common songbirds has been lost.

Q25 How likely is it that you would use these areas near Anaconda if they were not affected by hazardous substances? (Circle number of best answer.)

NOT AT ALL LIKELY — EXTREMELY LIKELY

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

HOW VALUABLE IS CLEANING UP THE CLARK FORK NPL SITES?

Your answers to the next questions are very important. The full cost of cleanup at the Clark Fork sites is not yet known. However, to make decisions about cleanup programs that could cost you money, it is important to know how much it is worth to you to clean up the Clark Fork River basin.

Q26 From least important to most important, how would you rank each of the following reasons for cleaning up hazardous substances and reducing impacts to air, land, water, wildlife, and fish in the Clark Fork River basin? (Circle the best response for each.)

	NOT AT ALL IMPORTANT ▼						EXTREMELY IMPORTANT ▼
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH FOR CURRENT USE BY MY FAMILY AND MYSELF	1	2	3	4	5	6	7
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH FOR CURRENT USE BY OTHERS	1	2	3	4	5	6	7
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH FOR USE BY FUTURE GENERATIONS	1	2	3	4	5	6	7
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH, EVEN IF NO ONE EVER USES THEM	1	2	3	4	5	6	7

Q27 Everyone will have to pay if the Clark Fork NPL sites are to be cleaned up. This includes the responsible industry, the Environmental Protection Agency, and the citizens of Montana. Since industry and the Environmental Protection Agency are already paying, what additional methods for raising money to clean up the Clark Fork River basin NPL sites might you support? This money would only go to the Clark Fork sites in Montana. (Circle all that apply.)

1 INCREASE IN WASTE DISPOSAL FEES AND TAXES PAID BY INDUSTRY. INDUSTRY WOULD PASS ALONG SOME OF THESE COSTS TO YOU IN HIGHER PRICES FOR ALL GOODS AND SERVICES YOU BUY.

2 INCREASE IN WASTE DISPOSAL (TRASH COLLECTION) BILLS YOU PAY

3 INCREASE IN WATER BILLS YOU PAY

4 INCREASE IN STATE TAXES YOU PAY

5 INCREASE IN THE COST OF HUNTING AND FISHING LICENSES

6 HIGHWAY TOLLS ON RESIDENTS AND NON-RESIDENTS USING I-90 IN THE AFFECTED AREA

7 OTHER (Please specify)_____

Complete Cleanup of the Clark Fork NPL Sites

We would like to know what it would be worth to you and your household to completely clean up hazardous substances at the Clark Fork NPL sites. When answering, assume that:

➢ "Complete cleanup" would include the methods discussed in Q4 for surface water, Q8 for groundwater, and Q12 for soil, vegetation, and wildlife. These methods are summarized briefly below:

- Surface Water: sources of contamination would be removed and streamside vegetation would be replanted. Water quality, fish populations, soil, vegetation, and wildlife habitat would return to normal levels. After cleanup, contaminated rivers that previously looked like photo 1 would look like a combination of photos 2 and 3 (see insert).

- Groundwater: sources of contamination would be isolated from groundwater; contaminated water would be pumped, treated, and reinjected into the ground. After cleanup, the groundwater would no longer be contaminated.

- Soil, Vegetation, and Wildlife: contaminated soil would be removed, and new soil would be imported. Natural vegetation would be replanted, and wildlife habitat would be restored to normal.

➢ New programs would use best available technologies and could be guaranteed to restore impacted natural resources to the conditions that would have occurred if hazardous substances had not been released.

➢ Costs would be paid by a combination of households, industry, and government agencies using the methods you chose in Q27 above.

➢ If cleanup efforts cost less than people are willing to pay, the fees would be lowered so that everyone would only pay a share of what complete cleanup actually costs.

Q28 What is the most your household would be willing to pay each year for 10 years through the methods you selected in Q27 to fund efforts to achieve complete cleanup of hazardous substances the Clark Fork NPL sites in Montana? (Circle the amount you would pay annually for 10 years.)

$0	$3	$10	$40	$125	$450	$1,500	$5,000
$1	$5	$15	$60	$200	$650	$2,250	MORE THAN $5,000
$2	$8	$25	$90	$300	$1,000	$3,300	

Q29 It is important that we understand your response. Please provide any additional comments that help to explain your answer to Q28 above.

_____

_____

Q30 Some people tell us it is difficult to think about paying to clean up just one site or even just one environmental problem. Would you say the dollar amount in Q28 you stated your household would be willing to pay is: (Circle number of best answer.)

1 JUST FOR CLEANUP AT THE CLARK FORK RIVER BASIN. GO TO Q32.

2 PARTLY FOR CLEANUP AT THE CLARK FORK RIVER BASIN AND PARTLY TO CLEAN UP OTHER HAZARDOUS WASTE SITES.

3 BASICALLY A CONTRIBUTION FOR ALL ENVIRONMENTAL OR OTHER CAUSES.

4 OTHER (PLEASE SPECIFY)_____

Q31 What percent of your answer to Q28 is just for cleanup at the Clark Fork NPL sites? (Circle best answer.)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q32 Of the money your household would be willing to pay for complete cleanup at the Clark Fork NPL sites, about what percent do you think should be spent on:

_____ % SURFACE WATER, AQUATIC LIFE, AND RIVER HABITAT CLEANUP

_____ % GROUNDWATER CLEANUP

_____ % SOIL, VEGETATION, AND WILDLIFE HABITAT CLEANUP

_____ % OTHER IMPACTS (Please specify)_____

TOTAL = 100%

Partial Cleanup of the Clark Fork NPL Sites

If complete cleanup is not technically feasible or is too expensive, other actions could be undertaken to partially clean up hazardous substances at the Clark Fork NPL sites. We would like to know what it would be worth to you and your household to undertake actions to partially clean up hazardous substances at the Clark Fork NPL sites in Montana. When answering, assume that:

➢ "Partial cleanup" would include the methods discussed in Q5 for surface water, Q9 for groundwater, and Q13 for soil, vegetation, and wildlife. These methods are summarized briefly below:

- Surface Water: contaminated materials would be pulled back from the water's edge and streambanks would be replanted with grasses. Water quality would improve, but the number of trout would remain below normal. About one-fourth of the habitat currently lost for wildlife species such as great blue heron, white-tailed deer, and various birds would be restored.

- Groundwater: contamination of groundwater would remain, but sources of contamination would be isolated from groundwater to limit further contamination.

- Soil, Vegetation, and Wildlife: the most contaminated soils and waste deposits would be removed and placed in a landfill. These areas would be replanted with grasses and some trees. Roughly one-third of the habitat currently lost for wildlife species such as elk, pine marten, blue grouse, and various birds would be restored.

➢ Costs would be paid by a combination of households, industry, and government agencies through the methods you chose in Q27 above.

➢ If cleanup efforts cost less than people are willing to pay, the fees would be lowered so that everyone would only pay a share of what partial cleanup actually costs.

Q33 Of the money your household would be willing to pay for complete cleanup at the Clark Fork River NPL sites (from Q28), about what percent would you be willing to pay for partial cleanup of hazardous substances? (Circle best answer.)

NONE					HALF					SAME	MORE
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	>100%

Q34 Do you feel responsible to help pay for cleanup at the Clark Fork River basin? (Circle number of best answer.)

NOT AT ALL RESPONSIBLE						EXTREMELY RESPONSIBLE
1	2	3	4	5	6	7

ABOUT YOU AND YOUR HOUSEHOLD

Q35 How many years have you lived in Montana? _____ YEARS

Q36 What Montana county do you live in? _____ COUNTY

Q37 Your present age: _____ YEARS

Q38 Your sex. (Circle number of your answer.)

1 MALE 2 FEMALE

Q39 What is your present employment status? (Circle number of best answer.)

1 EMPLOYED FULL TIME
2 EMPLOYED PART TIME
3 FULL-TIME HOMEMAKER
4 UNEMPLOYED
5 RETIRED
6 STUDENT

Q40 Including yourself, how many members in your household are in each age group? (If none, write "0".)

___ UNDER 18 YEARS OF AGE
___ 18-64
___ 65 AND OVER

Q41 In the past month, has your household recycled newspaper, glass, aluminum, or other materials? (Circle number of best answer.)

1 NO
2 YES

Q42 In the past year, have you held membership or donated time or money to any environmental organizations or groups (such as the Montana Wilderness Association or the Sierra Club)? (Circle number of best answer.)

1 NO
2 YES–ONE GROUP
3 YES–TWO OR MORE GROUPS

Q43 What was the highest grade of school you completed? (Circle one number.)

1 SOME HIGH SCHOOL OR LESS
2 HIGH SCHOOL GRADUATE
3 SOME COLLEGE, TRADE OR VOCATIONAL SCHOOL
4 TRADE OR VOCATIONAL SCHOOL GRADUATE
5 COLLEGE GRADUATE
6 SOME GRADUATE SCHOOL
7 ADVANCED DEGREE

Q44 What was your approximate total household income in 1992 before taxes and deductions? Please include all income to this household including social security, interest, welfare payments, child support, etc. (Circle one number.)

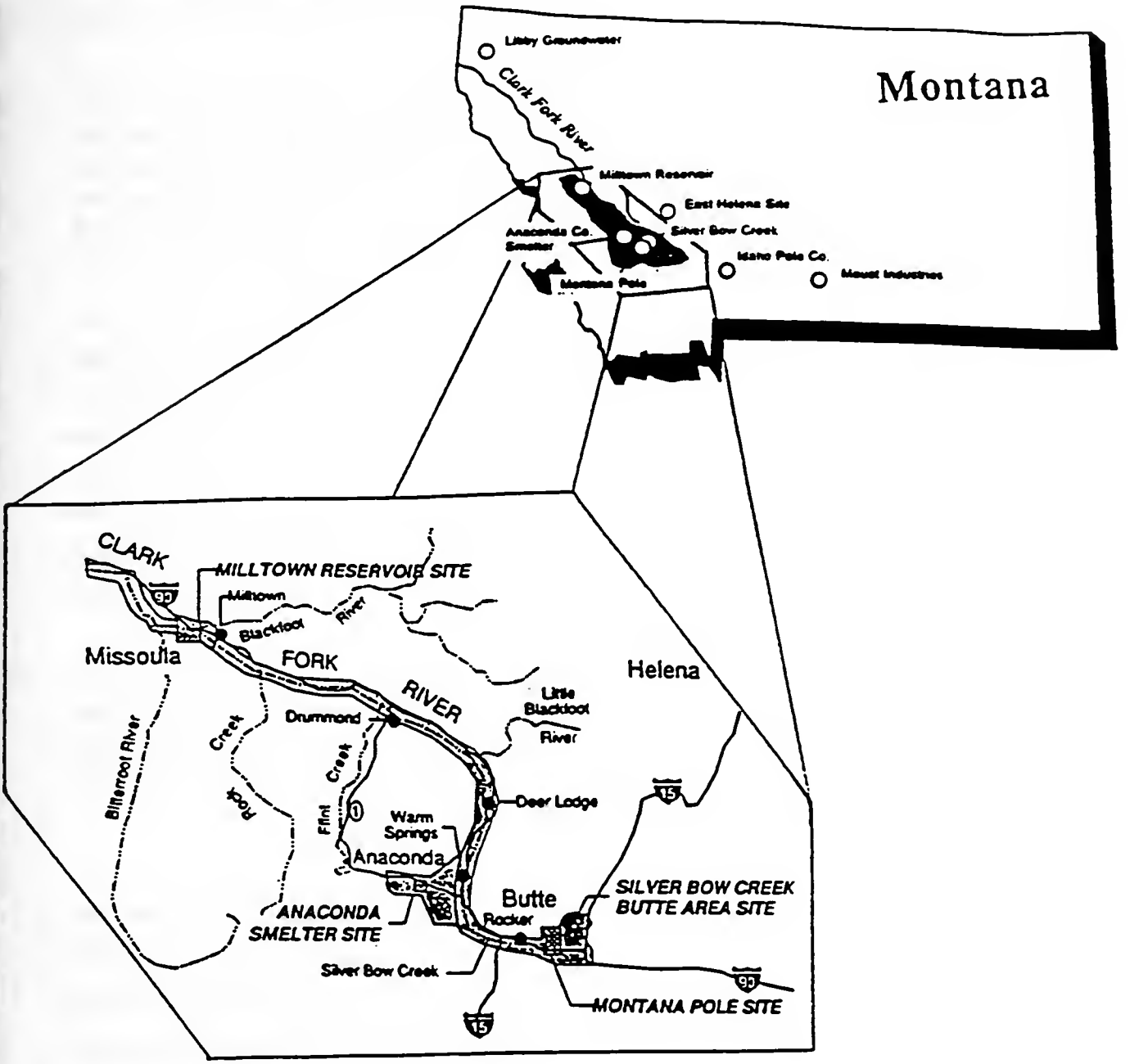
1	UNDER $10,000	6	$40,000 - $49,999	11	$100,000 - $124,999
2	$10,000 - $14,999	7	$50,000 - $59,999	12	$125,000 - $149,999
3	$15,000 - $19,999	8	$60,000 - $69,999	13	$150,000 - $200,000
4	$20,000 - $29,999	9	$70,000 - $79,999	14	MORE THAN $200,000
5	$30,000 - $39,999	10	$80,000 - $99,999	15	CHOOSE NOT TO ANSWER

Is there anything we overlooked? Please use this space for any additional comments.

YOUR PARTICIPATION IS GREATLY APPRECIATED!

V1

Cleaning Up Hazardous Wastes in Montana
The Clark Fork River Basin: What is Your Opinion?



Research Conducted by RCG/Hagler, Bailly, Inc.

Please return survey to:
RCG/Hagler, Bailly, Inc.
P.O. Box 1885
Great Falls, MT 59403-9833
1-800-568-0974

Version 2

INTRODUCTION

While providing jobs and producing goods and services used by everyone, many Montana industries also produce hazardous substances in their wastes. These hazardous substances can harm water, land, plants, and animals, and may reduce people's opportunities to enjoy Montana's natural resources for recreation and other uses.

Q1 There are over 250 sites in Montana where hazardous substances may be present. Some sites are old and abandoned, and some are still being used. Eight sites have been put on the U.S. Environmental Protection Agency's National Priorities List (NPL) for cleanup and are called Superfund sites. The eight NPL sites are identified on the map on the cover of this questionnaire. Have you seen, heard, or read about the NPL sites listed below? (Circle NO or YES for <u>each</u> site.)

SILVER BOW CREEK/BUTTE AREA SITE	NO	YES
MONTANA POLE SITE	NO	YES
ANACONDA SMELTER SITE	NO	YES
MILLTOWN RESERVOIR/CLARK FORK RIVER SITE	NO	YES
EAST HELENA SITE	NO	YES
IDAHO POLE COMPANY SITE	NO	YES
MOUAT INDUSTRIES SITE	NO	YES
LIBBY GROUNDWATER SITE	NO	YES

Q2 Policy makers need to understand how important it is to you to clean up hazardous waste sites compared to other issues also facing the citizens of Montana. From not at all important to extremely important, how would you rate each of the issues listed below? (Circle number of best response for each issue.)

	NOT AT ALL IMPORTANT ▼						EXTREMELY IMPORTANT ▼
IMPROVING THE EDUCATION SYSTEM	1	2	3	4	5	6	7
REDUCING AIR POLLUTION	1	2	3	4	5	6	7
BRINGING NEW JOBS TO THE STATE	1	2	3	4	5	6	7
IMPROVING PUBLIC ROADS AND HIGHWAYS	1	2	3	4	5	6	7
PRESERVING WILDERNESS AREAS	1	2	3	4	5	6	7
PROMOTING RECYCLING	1	2	3	4	5	6	7
CLEANING UP HAZARDOUS SUBSTANCES AT SITES	1	2	3	4	5	6	7

IMPACTS AND CLEANUP OF HAZARDOUS SUBSTANCES

This section discusses how hazardous substances from mining and other industries can harm natural resources and describes different methods that can be implemented to clean up these hazardous substances. Note that cleaning up the hazardous substances at sites will not return the environment to completely "natural" conditions. Impacts from agriculture, highways, and other human causes will not be cleaned up; sites will only be restored to conditions that would have existed if the hazardous substances had not been released. **(Please unfold the color insert enclosed with the survey and look at Figures 1, 2, and 3.)**

Contamination and Cleanup of Surface Water

Surface water (streams, lakes, and ponds) provides habitat for fish, insects, birds, and other animals, and supports recreational activities such as swimming, fishing, and boating.

When water flows through contaminated soils, floodplain sediments, or industrial waste piles (such as a tailings pile made up of mining and milling wastes), it can pick up contaminants and carry them into streams and rivers **(A, B, and C in Figure 1 on insert)**. Surface water contaminated with industrial and mining wastes can affect fish, groundwater, and streamside plants. Hazardous substances in high concentrations may be toxic to living organisms.

Q3 How important would you say that surface water contamination issues in Montana are to you? (Circle number of best answer.)

NOT AT ALL IMPORTANT — EXTREMELY IMPORTANT

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

We would like you to consider several cleanup options for surface water: complete cleanup, partial cleanup, and an alternative option.

Q4 **Complete Cleanup of Surface Water.** Sources of contamination would be removed. For example, mine tailings and contaminated streambed sediments would be removed and placed in a landfill. Water quality would return to conditions that would have existed without contamination, and fish populations would return to normal levels. New soil would be placed along streambanks, and streamside trees, shrubs, and grasses would be planted to provide natural wildlife habitat. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q5 **Partial Cleanup of Surface Water.** Contaminated materials along streambanks would be pulled back from the water's edge and streambanks would be planted with grasses. Water quality would improve, but rainstorms and snowmelt occasionally would flush contamination into the river causing poor water quality. The number of fish would increase, but would remain below normal levels because of contamination in streambed sediments. Shrubs and trees typical of the area would not be planted, and habitat for some species of wildlife would be permanently lost. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q6 **Alternative Option.** Contaminated areas would not be cleaned up. However, uncontaminated stream or riverside lands with in-stream water rights, wildlife habitat, and fishing or other recreational access similar to the impacted area before it was contaminated could be purchased by the State. These lands would be held in trust by the State to ensure that their natural resources remain protected in the future. How satisfied would you be with this alternative option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Contamination and Cleanup of Groundwater

Groundwater exists below ground, usually in small spaces in rocks or sediment. Groundwater flows much more slowly than surface water, often no more than a few feet to a few hundred feet a year. The direction in which groundwater flows depends on gravity and the type of material that holds the water **(see B in Figure 2 on insert)**. When surface water (streamflow, runoff, or rainfall) seeps through soil containing hazardous substances, hazardous substances in the soil will be dissolved into the groundwater **(see A in Figure 2)**. Movement of contaminated groundwater can cause contamination to spread over a larger area. Until the sources of hazardous substances are removed or are isolated from groundwater, contamination can continue to spread.

Q7 How important would you say that groundwater contamination issues in Montana are to you? (Circle number of best answer.)

NOT AT ALL IMPORTANT — EXTREMELY IMPORTANT

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

We would like you to consider several cleanup options for groundwater:

Q8 **Complete Cleanup of Groundwater.** Sources of contamination would be isolated from groundwater or, at small sites, removed. Underground barriers would be built to limit the spread of contamination into clean groundwater. Contaminated groundwater would be pumped up to the surface and treated. The clean water would be reinjected underground. About the same amount of clean water would be available as before the contamination occurred. How satisfied would you be with this option? (Circle best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q9 **Partial Cleanup of Groundwater.** Groundwater would remain contaminated. At small sites, sources of contamination would be either removed or isolated to limit further contamination. Use of the groundwater in contaminated areas would be prohibited. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q10 **Alternative Option.** Contaminated groundwater would not be cleaned up, nor would it be contained. However, water rights could be purchased to provide clean groundwater to replace the amount lost because of contamination. How satisfied would you be with this alternative option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Contamination and Cleanup of Air, Soil, Vegetation, and Wildlife

Soils can become contaminated by smoke stack emissions **(A in Figure 3 on Insert)**, or when contaminated material is blown onto nearby uncontaminated soils **(B)**. Rain and snow falling through the air pick up particles and "wash" them onto soils and water below **(C)**. Runoff from contaminated soils can contaminate surface water **(Figure 1)** and groundwater **(Figure 2)**. Hazardous substances in soils can cause toxic reactions in plants such as wilting, stunted growth, and death. The reduction or elimination of vegetation can affect the ability of the environment to provide habitat for wildlife that rely on plants for food or protection, although animals may be seen passing through impacted areas.

Q11 How important would you say air, soil, vegetation, and wildlife contamination issues in Montana are to you? (Circle number of best answer.)

NOT AT ALL IMPORTANT — EXTREMELY IMPORTANT

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

We would like you to consider several cleanup options for soil, vegetation. and wildlife:

Q12 **Complete Cleanup of Soil, Vegetation, and Wildlife.** The most highly contaminated soils would be removed and put in a landfill. In less contaminated areas, a top layer of uncontaminated soil would be added. The entire area would then be replanted with native grasses, trees, and shrubs. The area would provide similar vegetation and approximately the same amount of habitat for wildlife as would have been available before contamination occurred. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q13 **Partial Cleanup of Soil, Vegetation, and Wildlife.** The most contaminated soils and waste deposits would be removed and placed in a landfill. These areas would be replanted with grasses and some trees. Wildlife habitat would not be fully restored and would be permanently lost over the majority of the contaminated area. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q14 **Alternative Option.** Contaminated areas would not be cleaned up. However, land that would provide soil, vegetation, wildlife habitat, and recreational access similar to the impacted area before it was contaminated could be purchased by the State. These lands would be held in trust by the State to ensure that their natural resources are preserved in the future. How satisfied would you be with this option? (Circle number of best answer.)

NOT AT ALL SATISFIED — EXTREMELY SATISFIED

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

ABOUT MONTANA'S NPL SITES

Montana currently has eight hazardous waste sites on the U.S. Environmental Protection Agency's National Priority List (NPL) **(see cover)**. Four of these sites are described below.

Q15 The East Helena Site. For over 100 years, lead and zinc smelting operations have released contaminants around the city of East Helena. Surface soils and groundwater located in an eight and a half-square mile area of residential and rural agricultural land around the smelter contain hazardous substances. How important to you is it to clean up hazardous substances at the East Helena Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT — EXTREMELY IMPORTANT

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Q16 The Idaho Pole Company Site is a 50-acre wood treatment facility located in Bozeman. Past spills and disposal practices resulted in the contamination of soil, groundwater, and surface water on site. How important to you is it to clean up hazardous substances at the Idaho Pole Company Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q17 The Mouat Industries Site is located in Columbus. In the late 1950s and early 1960s ore processing produced wastes containing chromium, a hazardous substance. At this two-acre site, both groundwater and soils are contaminated. A plant is being constructed to treat soils. How important to you is it to clean up hazardous substances at the Mouat Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q18 The Libby Groundwater Contamination Site is located in Libby. For 23 years, wood treating fluids were disposed of and spilled at several different locations on the mill property. In 1979, the Environmental Protection Agency found the soil and groundwater at the site to be contaminated. Groundwater contamination extends into the city of Libby. Residents have been provided with an alternate water supply and treatment of contaminated soil is taking place. However, groundwater at the site is likely to remain contaminated for decades or more. How important to you is it to clean up hazardous substances at the Libby Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

ABOUT THE CLARK FORK NATIONAL PRIORITY LIST SITES

The remaining four NPL sites are located in the Clark Fork River basin from Butte to Milltown, an area with about 60,000 people **(see Map A on Insert)**. Impacts at the sites have largely resulted from releases of hazardous substances from historic mining activities. These historical activities were subject to less stringent regulations than are applicable today. *[Note that an acre is about 4/5ths the size of a football field. An acre-foot of water is the amount of water needed to cover an acre to a depth of one foot; this is about the amount of water that two typical Montana households use in a year.]*

Q19 The Silver Bow Creek and Butte Area Site includes the Butte area, the Berkeley Pit, 24 miles of Silver Bow Creek, and the Warm Springs Ponds **(Map A)**. The Berkeley Pit was excavated to mine ore in Butte. It now contains approximately 50,000 acre-feet of contaminated water.

The Warm Springs Ponds were built to reduce the flow of hazardous substances into the Clark Fork River by settling them out of Silver Bow Creek. The ponds now contain roughly 15 million cubic yards of contaminated sediments. Mining and milling operations have contaminated groundwater throughout a large portion of the Butte area. Silver Bow Creek can no longer support fish because of surface water contamination, and wildlife such as otter that rely on fish for food cannot use the area.

About 750 acres of soils along Silver Bow Creek have been contaminated to the extent that little streamside vegetation, such as willow shrubs and cottonwood trees, can survive. This has caused wildlife habitat to be lost for species such as white-tailed deer, great blue heron, common songbirds such as flycatchers and sparrows, and birds of prey such as red-tailed hawks. How important to you is it to clean up hazardous substances at the Silver Bow Creek and Butte Area Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q20 The Montana Pole Site is a former wood treating facility located in west Butte adjacent to Silver Bow Creek and Interstate Highway 90 (I-90) **(Map A)**. From 1946 to 1983, the facility was used to preserve utility poles, posts, and bridge timbers with the hazardous substance pentachlorophenol (PCP). Approximately 20 acres of soils and about 200 acre-feet of groundwater have been contaminated. How important to you is it to clean up hazardous substances at the Montana Pole Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q21 The Anaconda Smelter Site is near the town of Anaconda **(Map A)**. Smelting operations at the site continued from 1884 through 1980 and hazardous substances were released as tailings, flue dust, and stack emissions. For example, in the mid-1970s the smelter released about five tons of copper and six tons of arsenic into the air each day contaminating soils. This has harmed vegetation such as grasses, willow shrubs, and Douglas-fir and lodgepole pine trees. Because of this, wildlife habitat has been lost over about a 15-square mile area for species such as elk, pine marten, blue grouse, and various common songbirds such as warblers, bluebirds, and thrushes. How important to you is it to clean up hazardous substances at the Anaconda Smelter Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 EXTREMELY IMPORTANT

Q22 The Milltown Reservoir/Clark Fork River Site includes 120 miles of the Clark Fork River between Warm Springs Ponds and the Milltown Reservoir **(Map A)**. Along this stretch of the Clark Fork River, surface water and streambed sediments have been contaminated with hazardous substances from mining, milling, and smelting. Because of the toxic effects of this contamination, trout populations have been reduced to, on average, about one-quarter of what they could be without contamination.

About 250 acres of soils along the upper Clark Fork River have been contaminated to the extent that little streamside vegetation, such as willow shrubs and cottonwood trees, can survive. This has caused wildlife habitat to be lost for species such as white-tailed deer, great blue heron, common songbirds such as flycatchers and sparrows, and birds of prey such as red-tailed hawks. Contaminated sediments from the Clark Fork River have been trapped in the reservoir behind the Milltown dam and have contaminated groundwater in the area. How important to you is it to clean up hazardous substances at the Milltown Reservoir/Clark Fork River Site? (Circle number of best answer.)

NOT AT ALL IMPORTANT — EXTREMELY IMPORTANT

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

NATURAL RESOURCE IMPACTS AT THE CLARK FORK NPL SITES

This section discusses current natural resource impacts in the Clark Fork River basin caused by historic and continuing releases of hazardous substances.

Surface Water Resources (See Photos 1, 2, and 3 on Insert)

Currently, because of contamination of surface water, all trout, as well as virtually all other fish, have been eliminated from Silver Bow Creek. Wildlife that rely on fish for food, such as otter, cannot use the area. In 120 miles of the Clark Fork River between Warm Springs Ponds and Milltown, the number of trout present in the river has been reduced to, on average, about one-quarter of what could be there if contamination were not present. Otter are also not found here.

Contamination of streambanks along Silver Bow Creek and the upper 17 miles of the Clark Fork River between Warm Springs Ponds and Deer Lodge has resulted in the virtual elimination of streamside vegetation such as grasses, willow shrubs, and cottonwood trees on approximately 750 acres of Silver Bow Creek and 250 acres of the Clark Fork River. Because of this, wildlife habitat for many species such as white-tailed deer, great blue heron, birds of prey such as red-tailed hawks, and various common songbirds such as flycatchers and sparrows has been eliminated in these stretches.

Q23 How likely is it that you would use these areas along the Silver Bow Creek and Clark Fork River if they were not affected by hazardous substances? (Circle number of best answer.)

NOT AT ALL LIKELY — EXTREMELY LIKELY

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Groundwater Resources

Currently, roughly 800,000 acre-feet of groundwater at several sites in the Clark Fork River basin have been contaminated so that it cannot be used for drinking without treatment.

In the Silver Bow Creek and Butte Hill Area, about 500,000 acre-feet of groundwater have been contaminated. The city's current water needs have been met by a water diversion provided by industry.

Near the Warm Springs Ponds and the town of Anaconda, about 300,000 acre-feet of groundwater have been contaminated, mostly under land currently owned by industry. About 5,000 acre-feet of groundwater previously used by residents of the town of Milltown have been contaminated. Industry and the U.S. Environmental Protection Agency have moved the town's wells to clean areas in the same groundwater aquifer. Use of wells in the contaminated area is not permitted.

Q24 How likely do you think it is that contaminated groundwater in the Clark Fork River basin will be needed for future use? (Circle number of best answer.)

NOT AT ALL LIKELY — EXTREMELY LIKELY

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

Air, Soil, Vegetation, and Wildlife Resources (See Photos 4, 5, and 6 on Insert)

Currently, hazardous substances in smelter emissions have contaminated soils causing severe impacts to trees such as Douglas-fir and lodgepole pine, shrubs such as willows, and various grasses over an approximately 9,600-acre area (about 15 square miles) near Anaconda that includes Smelter Hill, portions of Mt. Haggin, and Stucky Ridge. This has caused habitat to be lost in this area for wildlife species including elk, pine marten, blue grouse, birds of prey such as red-tailed hawks, and common songbirds such as bluebirds, thrushes, and warblers.

Mining wastes containing hazardous substances were disposed of on about five square miles in the Opportunity Tailings Ponds area between Anaconda and Warm Springs Ponds. This has caused the elimination of vegetation such as grasses and willow shrubs. Wildlife habitat for species such as white-tailed deer and various common songbirds has been lost.

Q25 How likely is it that you would use these areas near Anaconda if they were not affected by hazardous substances? (Circle number of best answer.)

NOT AT ALL LIKELY — EXTREMELY LIKELY

1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7

HOW VALUABLE IS CLEANING UP THE CLARK FORK NPL SITES?

Your answers to the next questions are very important. The full cost of cleanup at the Clark Fork sites is not yet known. However, to make decisions about cleanup programs that could cost you money, it is important to know how much it is worth to you to clean up the Clark Fork River basin.

Q26 From least important to most important, how would you rank each of the following reasons for cleaning up hazardous substances and reducing impacts to air, land, water, wildlife, and fish in the Clark Fork River basin? (Circle the best response for each.)

	NOT AT ALL IMPORTANT ▼						EXTREMELY IMPORTANT ▼
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH FOR CURRENT USE BY MY FAMILY AND MYSELF	1	2	3	4	5	6	7
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH FOR CURRENT USE BY OTHERS	1	2	3	4	5	6	7
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH FOR USE BY FUTURE GENERATIONS	1	2	3	4	5	6	7
TO CLEAN UP AIR, LAND, WATER, WILDLIFE, AND FISH, EVEN IF NO ONE EVER USES THEM	1	2	3	4	5	6	7

Q27 Everyone will have to pay if the Clark Fork NPL sites are to be cleaned up. This includes the responsible industry, the Environmental Protection Agency, and the citizens of Montana. Since industry and the Environmental Protection Agency are already paying, what additional methods for raising money to clean up the Clark Fork River basin NPL sites might you support? This money would only go to the Clark Fork sites in Montana. (Circle all that apply.)

1 INCREASE IN WASTE DISPOSAL FEES AND TAXES PAID BY INDUSTRY. INDUSTRY WOULD PASS ALONG SOME OF THESE COSTS TO YOU IN HIGHER PRICES FOR ALL GOODS AND SERVICES YOU BUY.

2 INCREASE IN WASTE DISPOSAL (TRASH COLLECTION) BILLS YOU PAY

3 INCREASE IN WATER BILLS YOU PAY

4 INCREASE IN STATE TAXES YOU PAY

5 INCREASE IN THE COST OF HUNTING AND FISHING LICENSES

6 HIGHWAY TOLLS ON RESIDENTS AND NON-RESIDENTS USING I-90 IN THE AFFECTED AREA

7 OTHER (Please specify)_____

Partial Cleanup of the Clark Fork NPL Sites

Because complete cleanup of the Clark Fork River sites may not be technically feasible or may be too expensive, actions could be undertaken to partially clean up hazardous substances at the Clark Fork NPL sites. We would like to know what it would be worth to you and your household to undertake actions to partially clean up hazardous substances at the Clark Fork NPL sites in Montana. When answering, assume that:

➢ "Partial cleanup" would include the methods discussed in Q5 for surface water, Q9 for groundwater, and Q13 for soil, vegetation, and wildlife. These methods are summarized briefly below:

- Surface Water: contaminated materials would be pulled back from the water's edge and streambanks would be replanted with grasses. Water quality would improve, but the number of trout would remain below normal. About one-fourth of the habitat currently lost for wildlife species such as great blue heron, white-tailed deer, and various birds would be restored.

- Groundwater: contamination of groundwater would remain, but sources of contamination would be isolated from groundwater to limit further contamination.

- Soil, Vegetation, and Wildlife: the most contaminated soils and waste deposits would be removed and placed in a landfill. These areas would be replanted with grasses and some trees. Roughly one-third of the habitat currently lost for wildlife species such as elk, pine marten, blue grouse, and various birds would be restored.

➢ Costs would be paid by a combination of households, industry, and government agencies through the methods you chose in Q27 above.

➢ If cleanup efforts cost less than people are willing to pay, the fees would be lowered so that everyone would only pay a share of what partial cleanup actually costs.

Q28 What is the most your household would be willing to pay each year for 10 years through the methods you selected in Q27 to fund efforts to achieve partial cleanup of hazardous substances at the Clark Fork NPL sites in Montana? (Circle the amount you would pay annually for 10 years.)

$0	$3	$10	$40	$125	$450	$1,500	$5,000
$1	$5	$15	$60	$200	$650	$2,250	MORE THAN $5,000
$2	$8	$25	$90	$300	$1,000	$3,300	

Q29 It is important that we understand your response. Please provide any additional comments that help to explain your answer to Q28 above.

_____

_____

Q30 Some people tell us it is difficult to think about paying to clean up just one site or even just one environmental problem. Would you say the dollar amount in Q28 you stated your household would be willing to pay is: (Circle number of best answer.)

1 JUST FOR CLEANUP AT THE CLARK FORK RIVER BASIN. GO TO Q32.

_____ 2 PARTLY FOR CLEANUP AT THE CLARK FORK RIVER BASIN AND PARTLY TO CLEAN UP OTHER HAZARDOUS WASTE SITES.

_____ 3 BASICALLY A CONTRIBUTION FOR ALL ENVIRONMENTAL OR OTHER CAUSES.

_____ 4 OTHER (PLEASE SPECIFY)_____

→ Q31 What percent of your answer to Q28 is just for cleanup at the Clark Fork NPL sites? (Circle best answer.)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Q32 Of the money your household would be willing to pay for partial cleanup at the Clark Fork NPL sites, about what percent do you think should be spent on:

_____ % SURFACE WATER, AQUATIC LIFE, AND RIVER HABITAT CLEANUP

_____ % GROUNDWATER CLEANUP

_____ % SOIL, VEGETATION, AND WILDLIFE HABITAT CLEANUP

_____ % OTHER IMPACTS (Please specify)_____

TOTAL = 100%

Complete Cleanup of the Clark Fork NPL Sites

Suppose that complete cleanup of the Clark Fork NPL sites is technically feasible. We would like to know what it would be worth to you and your household to completely clean up hazardous substances at the Clark Fork NPL sites. When answering, assume that:

➢ "Complete cleanup" would include the methods discussed in Q4 for surface water, Q8 for groundwater, and Q12 for soil, vegetation, and wildlife. These methods are summarized briefly below:

- Surface Water: sources of contamination would be removed and streamside vegetation would be replanted. Water quality, fish populations, soil, vegetation, and wildlife habitat would return to normal levels. After cleanup, contaminated rivers that previously looked like photo 1 would look like a combination of photos 2 and 3 (see insert).

- Groundwater: sources of contamination would be isolated from groundwater; contaminated water would be pumped, treated, and reinjected into the ground. After cleanup, the groundwater would no longer be contaminated.

- Soil, Vegetation, and Wildlife: contaminated soil would be removed, and new soil would be imported. Natural vegetation would be replanted, and wildlife habitat would be restored to normal.

➢ New programs would use best available technologies and could be guaranteed to restore impacted natural resources to the conditions that would have occurred if hazardous substances had not been released.

➢ Costs would be paid by a combination of households, industry, and government agencies using the methods you chose in Q27 above.

➢ If cleanup efforts cost less than people are willing to pay, the fees would be lowered so that everyone would only pay a share of what complete cleanup actually costs.

Q33 Of the money your household would be willing to pay for partial cleanup at the Clark Fork River NPL sites (from Q28), about what percent would you be willing to pay for complete cleanup? (Circle best answer.)

LESS ▼	SAME ▼			4 TIMES AS MUCH ▼		6 TIMES AS MUCH ▼		MORE THAN 8 TIMES AS MUCH ▼
<100%	100%	200%	300%	400%	500%	600%	700%	800%+

Q34 Do you feel responsible to help pay for cleanup at the Clark Fork River basin? (Circle number of best answer.)

NOT AT ALL RESPONSIBLE 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ EXTREMELY RESPONSIBLE 7

ABOUT YOU AND YOUR HOUSEHOLD

Q35 How many years have you lived in Montana? _____ YEARS

Q36 What Montana county do you live in? _____ COUNTY

Q37 Your present age: _____ YEARS

Q38 Your sex. (Circle number of your answer.)

1 MALE 2 FEMALE

Q39 What is your present employment status? (Circle number of best answer.)

1 EMPLOYED FULL TIME
2 EMPLOYED PART TIME
3 FULL-TIME HOMEMAKER
4 UNEMPLOYED
5 RETIRED
6 STUDENT

Q40 Including yourself, how many members in your household are in each age group? (If none, write "0".)

___ UNDER 18 YEARS OF AGE
___ 18-64
___ 65 AND OVER

Q41 In the past month, has your household recycled newspaper, glass, aluminum, or other materials? (Circle number of best answer.)

1 NO
2 YES

Q42 In the past year, have you held membership or donated time or money to any environmental organizations or groups (such as the Montana Wilderness Association or the Sierra Club)? (Circle number of best answer.)

1 NO
2 YES–ONE GROUP
3 YES–TWO OR MORE GROUPS

Q43 What was the highest grade of school you completed? (Circle one number.)

1 SOME HIGH SCHOOL OR LESS
2 HIGH SCHOOL GRADUATE
3 SOME COLLEGE, TRADE OR VOCATIONAL SCHOOL
4 TRADE OR VOCATIONAL SCHOOL GRADUATE
5 COLLEGE GRADUATE
6 SOME GRADUATE SCHOOL
7 ADVANCED DEGREE

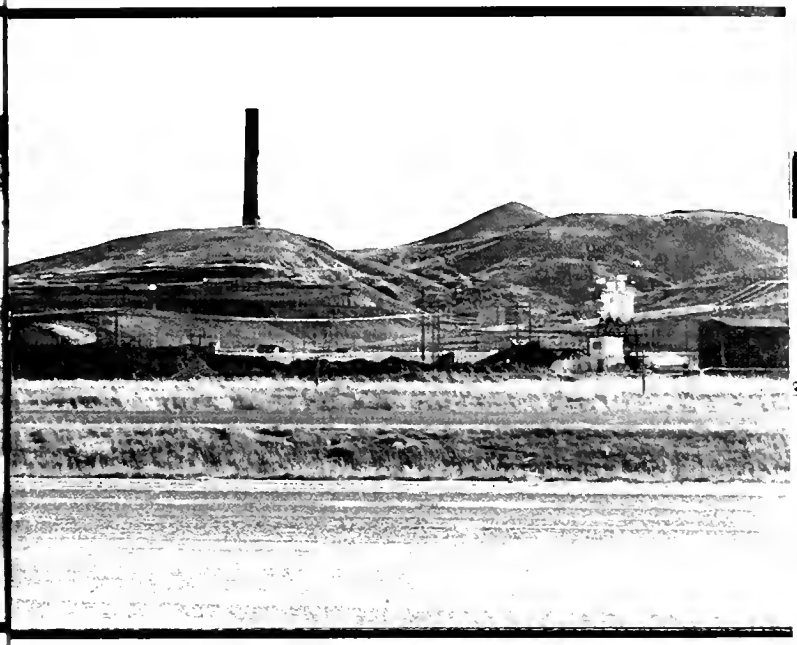
Q44 What was your approximate total household income in 1992 before taxes and deductions? Please include all income to this household including social security, interest, welfare payments, child support, etc. (Circle one number.)

1	UNDER $10,000	6	$40,000 - $49,999	11	$100,000 - $124,999
2	$10,000 - $14,999	7	$50,000 - $59,999	12	$125,000 - $149,999
3	$15,000 - $19,999	8	$60,000 - $69,999	13	$150,000 - $200,000
4	$20,000 - $29,999	9	$70,000 - $79,999	14	MORE THAN $200,000
5	$30,000 - $39,999	10	$80,000 - $99,999	15	CHOOSE NOT TO ANSWER

Is there anything we overlooked? Please use this space for any additional comments.

YOUR PARTICIPATION IS GREATLY APPRECIATED!

V2



< **Photo 1:**
Silver Bow Creek

< **Photo 2:**
If Silver Bow Creek were not contaminated, some parts of it would look similar to this. This area has been impacted by agriculture and grazing.

< **Photo 3:**
If Silver Bow Creek were not contaminated, some parts of it would look similar to this.

Photo 4: >
Anaconda Smelter and Smelter Hill impact area

Photo 5: >
Mt. Haggin impact area near Anaconda

Photo 6: >
If Anaconda were not contaminated, it would look similar to this.

Figure 1 — **Surface Water**

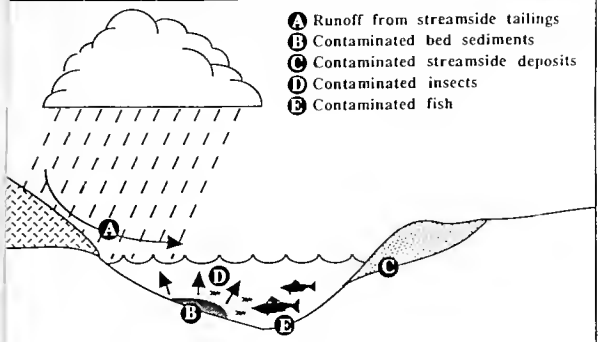


Figure 2 — **Ground Water**

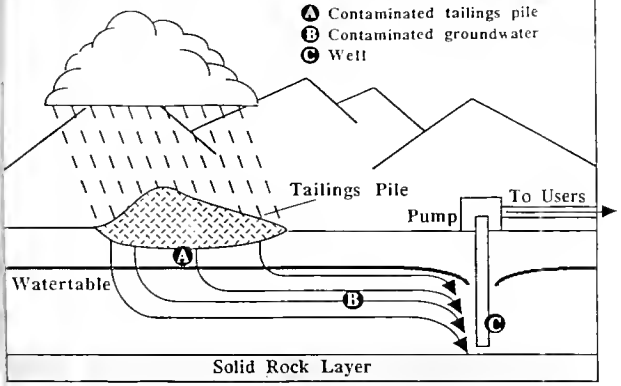
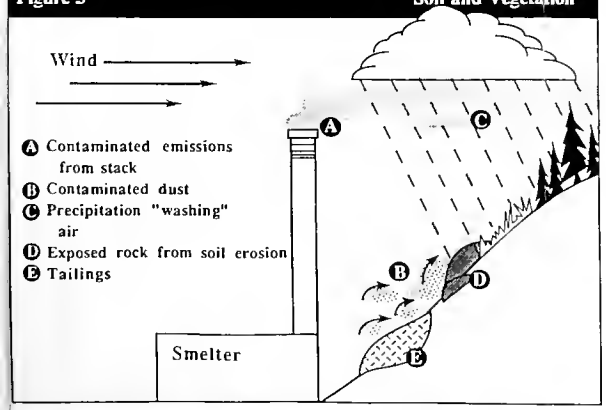
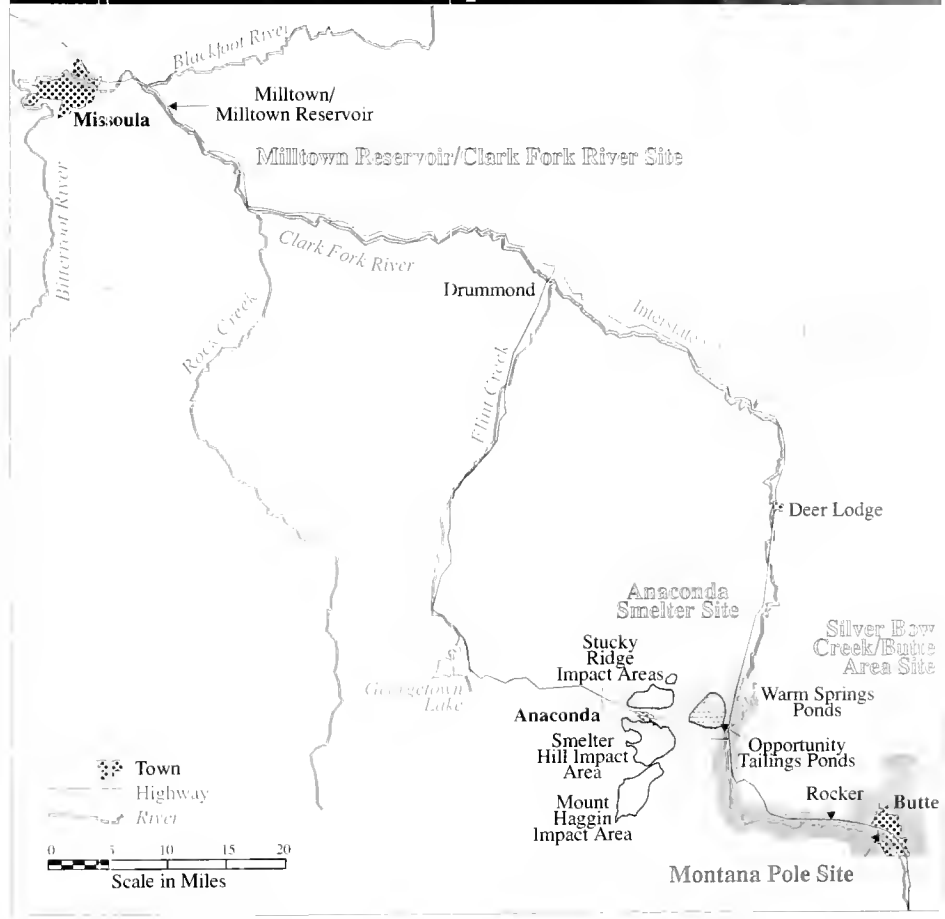


Figure 3 — **Soil and Vegetation**



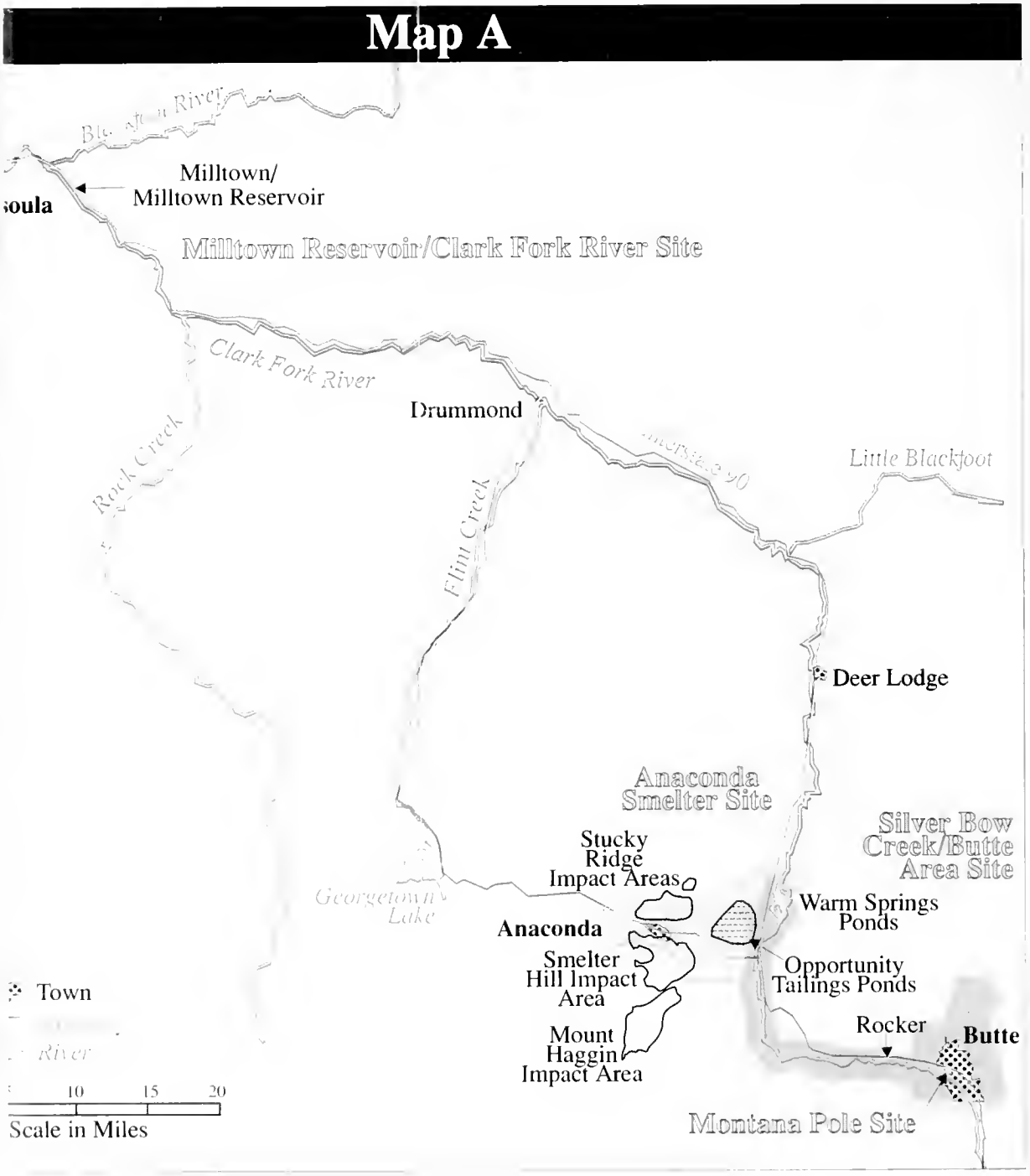
Map A



Clark Fork Basin Superfund Sites:

Anaconda Smelter Site, see Photos 4 and 5.
Milltown Reservoir/Clark Fork River Site
Silver Bow Creek/Butte Area Site, see Photo 1.
Montana Pole Site
Impact Area

Map A



Clark Fork Basin Superfund Sites:

Anaconda Smelter Site, see Photos 4 and 5.
Milltown Reservoir/Clark Fork River Site
Silver Bow Creek/Butte Area Site, see Photo 1.
Montana Pole Site
Impact Area

RCG/Hagler, Bailly, Inc.

P.O. Box 1885
Great Falls, MT 59403-9833

Respondent Name
Address
City State Zip

January 26, 1993

Dear Respondent:

Government and industry officials in Montana are evaluating what should be done about cleaning up hazardous waste sites in the state, particularly in the Clark Fork River basin. It is important that they be informed about how people like you really feel about these issues.

You have been selected as part of a small number of randomly selected households throughout Montana to participate in this very important study. Your questionnaire should be completed by either the male or the female head of your household. Whether you believe cleaning up hazardous waste sites is worthwhile or not, your opinion matters. The survey does not require that you have any special knowledge; we just ask that you take the time to consider each question and respond with your opinions.

We realize this survey will take some time to answer and that your time is valuable. **If you return your questionnaire, postmarked by February 10th, with all questions completed, we will send you a $20 "Thank You" check.**

A summary of the results of this study will be made available to government and industry representatives. If you would like a summary of the findings, simply put your name, address, and "copy of results requested" on the back of the return envelope.

Please help us by filling out the questionnaire and returning it promptly in the postage paid envelope provided. Your response is strictly confidential. The code number on the questionnaire is used only to allow us to send the $20 check to you for completing the survey. If you have any questions about this survey, please call me at 1-800-568-0974. Thank you for your help with this important matter and please remember that all questions must be answered for you to receive your $20.

Sincerely,

Rebecca Boyce
Survey Manager

February 2, 1993

Last week, a questionnaire was mailed to you seeking your opinions on cleaning up hazardous wastes in the Clark Fork River basin. You are one of only a small number of households in Montana selected to give your opinions on these matters.

If you have already completed and returned the questionnaire, accept our sincere thanks. You're check for $20 is on the way. If you have not completed and returned the questionnaire, we ask that you do so today. We are especially grateful for your help. Your responses will help shape decisions that government and industry will make on these important issues.

If by some chance you did not receive a questionnaire, or it was misplaced, please call us at 1 (800) 568-0974 and we will get another one to you in the mail today. Remember, **If you return your questionnaire, postmarked by February 10, with all questions completed, we will send you a $20 "Thank You" check.**

Sincerely,

Rebecca Boyce

Rebecca Boyce, Survey Manager

GENERAL INSTRUCTIONS

1. Try to reach each respondent several times at different times of the day. A total of at least four attempts should be made over a three day period. Treat automatic answering machines as No Answer.

2. Introductions, questions and responses that are to be read are in upper and lower case letters. Responses not read to respondents, but to be checked are in LARGE CAPS. Instructions for interviewer, and not read to the respondent are in **[bold within brackets]**.

3. Do not volunteer any information. The question and answer page will help you respond to any questions they may pose. Do not go beyond the information given on the quesuion and answer page. Simply state that you are a survey clerk hired to help with this project.

4. Make sure to record all numbers that are disconnected, respondents who are deceased, etc., and verify name and address. Try to get a commitment from people to fill out the survey. If another adult head of household agrees to fill out the survey, record name of that person as an address correction.

PROCEDURES

1. There are two distinct parts. PART 1 provides guidelines for initial contact and is used to determine if the respondent will or will not be sending in a survey.

2. All of PART 2 is to be used only for those people who indicate that they will not be completing the survey and sending it in.

3. Circle the number indicated for the appropriate response.

4. Be sure to enter respondent's ID number on the first page of PART 1 and other information requested from the interviewer on the last page of PART 2.

SOME QUESTIONS AND ANSWERS:

WHO IS RCG/HAGLER, BAILLY, INC?

A professional survey research firm that the state of Montana has hired to assist on this project.

WHO IS THIS SURVEY BEING DONE FOR?

It is being done for the Montana state government.

WHY ARE YOU DOING THIS SURVEY? WHAT IS THE PURPOSE OF THIS SURVEY?

The purpose of this survey is to find out how the public feels about clean-up options for the Clark Fork River hazardous waste sites in Montana.

[If pressed further –> When the state discusses clean-up with the Federal government and Private Industry the survey results will help the state understand how Montana citizens feel about different clean-up options and how these clean-up options affect them.]

[If pressed even further –> That is all I know about this project. I could arrange for you to speak with my supervisor, if you would like.]

WHY ALL THE INFORMATION ABOUT MY HOUSEHOLD? WHY DO YOU NEED TO KNOW INCOME, etc.?

First, let me assure you your responses are strictly confidential and are never tied to your name. For our survey to be representative of all people in Montana, we talk to different types of households. With this information we can test our sample to make sure it represents all of Montana.

THEY SHOULD DO ... THEY SHOULD NOT DO .... (The government, the state, etc.)

I will note that on the survey form to make sure it is included. Could we continue with the other questions I have?

I DON'T TRUST THEM

I will note that on the survey form to make sure it is included. All results will be made available to management agencies. Could we still continue with the other questions I have?

IS THIS CONFIDENTIAL?

Yes! Most definitely! All the information we release is in terms of the percent of respondents that provided certain answers to particular questions. In this form, no individual response can ever be identified. Moreover, the matter of confidentiality is terribly important to the success of our work, as we do many surveys. Thus, we are very careful to protect an individual's anonymity.

THE CLARK FORK RIVER BASIN IN MONTANA TELEPHONE FOLLOW-UP

Respondent ID# _____

Phone disconnected? 1. Yes 2. No

IF A YOUNG PERSON OR CHILD ANSWERS, ASK FOR AN ADULT HEAD OF HOUSEHOLD (MAN OR WOMAN)

Q1 Hello, is this the _____ residence?

1. YES
2. NO —>

IF NO THEN READ: **The number I was calling is** (Area Code & Phone Number) **and it was for** (Respondent's first & last name).

1. Respondent deceased
2. Respondent out of town or unavailable
3. Respondent has moved
4. Other (specify) _____
5. Respondent name unknown

[Go to Q2]

INTERVIEWER: If the number you were calling was correct but it is not the respondent's phone number, thank them for their time, and end the interview.

Q2 I'm with RCG/Hagler, Bailly, Inc. working with the State of Montana. Several weeks ago, we mailed a questionnaire to your address and offered to pay $20 to an adult head of household for filling it out. This survey is about "Cleaning up Hazardous Wastes in the Clark Fork River Basin." Do you remember receiving that questionnaire?

1. YES —> **[Go to Q3]**
2. NO —>

IF NO THEN READ: The questionnaire was printed in blue and it had a map of the State of Montana on the cover. It was sent with a letter that offered you $20 for completing the survey. Do you recall receiving it now?

1. YES —> **[Go to Q3]**
2. NO —>
3. DON'T KNOW —>

This survey is being conducted for the State of Montana and your household is part of a small group of people we are asking for opinions, so your response is very important to us so that our study truly represents the opinions of the citizens of Montana. If we sent you another survey could you find the time to complete the survey and return it to us within a week after you receive it? We will send you $20 for your time.

1. YES —> May I verify your name and address? **[Correct Name & Address]**

_____
_____
_____

Thank you. We will send you a survey within a week. **[end of interview]**

2. NO —> Is there another adult head of the household that would be interested in filling out the survey for $20?

   1. YES —> May I speak with them? If not home, log time to call back _____ and name _____
   2. NO —> **[Go to Q4]**

Q3 As of today we have not received your completed questionnaire. Your household is part of a small group we are asking for opinions, so your response is very important to us. We are extending the deadline for the $20 compensation. If we send you another survey, could you find the time to complete the survey and return it to us within a week of receiving it?

1 YES –> May I verify your name and address? **[Correct Name and Address]**

_____

_____

_____

Thank you. We will send you a survey within a week. **[end of interview]**

2 NO –> **[Be understanding and continue on with PART 2 ...]**

PART 2

FOR THOSE WHO WILL NOT BE RETURNING THE MAIL SURVEY

Q4 It is very important that we understand how those who do not return the survey compare to those who did. This way, we will not misinterpret the results. Could I take just 3 minutes to ask you a few questions?

_1_ NO –> **May I call back at a time that is more convenient?**
IF YES, ARRANGE A TIME _____
IF NO –> Thank you, I hope I have not inconvenienced you.

_2_ YES –> Thank you.

[If asked if this is the mail survey –>] This is not the mail survey, just six brief questions. It takes about 3 minutes.

There are over 250 sites in Montana where hazardous substances may be present. Some sites are old and abandoned, and some are still being used. Eight sites have been put on the U.S. Environmental Protection Agency's National Priorities List. The state of Montana would like to know what you think should be done about these sites.

Q5 It is useful to understand how important you feel cleaning up hazardous waste sites is compared to some of the many other issues facing citizens of Montana such as reducing air pollution, bringing new jobs to the state, or improving education in Montana. On a scale of 1 to 7 with 1 being least important, 4 being somewhat important and 7 being most important, how important do you rate cleaning up hazardous substances in Montana?

LEAST IMPORTANT			SOMEWHAT IMPORTANT		MOST IMPORTANT	
1	2	3	4	5	6	7

Q6 Four National Priority List sites are in the Clark Fork River Basin between Butte and Missoula. How much effort and expenditures do you feel should be made in the future to clean up hazardous substances in the Clark Fork River Basin in Montana? Would you say we should:

1 DO LESS AND SPEND LESS

2 DO AND SPEND ABOUT THE SAME AS WE HAVE BEEN DOING

3 DO MORE AND SPEND MORE

8 DON'T KNOW

I have just 4 more quick questions about your and your household to help us group your response with others.

Q7 How many years have you lived in Montana? _____ YEARS

Q8 What is your age? _____ YEARS

Q9 How many people live in your household? _____

Q10 What was your total household income in 1992, before taxes and deductions? I'll read off the categories, so just stop me when I reach the category which includes your household's 1992 income.

1 Less than $10,000

2 Between $10,000 and $19,900

3 Between $20,000 and $39,900

4 Between $40,000 and $59,900

5 Between $60,000 and $80,000

6 More than $80,000

Thank you. Goodbye.

INTERVIEWER ADD:

Interviewer Name _____

Q11 Respondent's Sex: Male Female

Q12 Language Barrier: 1 None 2 Possible Barrier 3 Definite Barrier

Q13 Any Comments:

RCG/Hagler, Bailly, Inc.

P.O. Box 1885
Great Falls, MT 59403-9833

Respondent Name
Address
City State Zip

March 3, 1993

Dear Respondent:

Enclosed is another copy of the questionnaire we discussed over the phone last week. Thank you for your willingness to complete and return this questionnaire promptly.

Government and industry officials in Montana are evaluating what should be done about cleaning up hazardous waste in the state, particularly in the Clark Fork River basin. It is important that they be informed about how people like you really feel about these issues.

You have been randomly selected as part of a small number of households throughout Montana to participate in this important study. Your questionnaire should be completed by either the male or the female head of your household. Whether you believe cleaning up hazardous waste is worthwhile or not, your opinion matters. The survey does not require that you have any special knowledge; we just ask that you take the time to consider each question and respond with your opinions.

We realize this survey will take some time to answer and that your time is valuable. **If you return your questionnaire, postmarked by Monday, March 15th, with all questions completed, we will send you a $20 "Thank You" check.**

A summary of the results of this study will be made available to government and industry representatives. If you would like a summary, simply put your name, address, and "copy of results requested" on the back of the return envelope.

Your response is strictly confidential. The code number on the questionnaire is used only to allow us to send the $20 check to you for completing the survey. If you have any questions about this survey, please call me at 1-800-568-0974. Thank you for your help with this important matter and please remember that all questions must be answered for you to receive your $20.

Sincerely,

Rebecca Boyce
Survey Manager

RCG/Hagler, Bailly, Inc.

P.O. Box 1885
Great Falls, MT 59403-9833

Respondent Name
Address
City State Zip

March 3, 1993

Dear Respondent:

Last month, a questionnaire was mailed to you seeking your opinions on cleaning up hazardous wastes in the Clark Fork River basin. As of today, we have not received your completed questionnaire.

Government and industry officials in Montana are evaluating what should be done in the Clark Fork River basin and it is important that they be informed about how people like you really feel about these issues.

You have been randomly selected as part of a small number of households throughout Montana to participate in this important study. Your questionnaire should be completed by either the male or the female head of your household. Whether you believe cleaning up hazardous waste is worthwhile or not, your opinion matters. The survey does not require that you have any special knowledge; we just ask that you take the time to consider each question and respond with your opinions.

We realize this survey will take some time to answer and that your time is valuable. **If you return your questionnaire, postmarked by Monday, March 15th, with all questions completed, we will send you a $20 "Thank You" check.**

A summary of the results of this study will be made available to government and industry representatives. If you would like a summary, simply put your name, address, and "copy of results requested" on the back of the return envelope.

Your response is strictly confidential. The code number on the questionnaire is used only to allow us to send the $20 check to you for completing the survey. If you have any questions about this survey, please call me at 1-800-568-0974. Thank you for your help with this important matter and please remember that all questions must be answered for you to receive your $20.

Sincerely,

Rebecca Boyce
Survey Manager

APPENDIX B
SURVEY PRETESTING

Appendix B discusses the survey pretesting steps and results. Section B.1 discusses the verbal protocol pretests. Sections B.2 and B.3 discuss the first and second iterations of the self-administered pretests.

B.1 PRETESTING USING VERBAL PROTOCOL METHODOLOGY

The first step in the formal pretesting process was to implement a verbal protocol procedure with a preliminary survey version. These interviews were conducted with 15 subjects in Missoula for three days at the end of October 1992. The subjects were interviewed individually, and they were asked to "think aloud" as they read through the survey and answered the survey questions. Subjects were paid $50, and each session lasted approximately two and one-half hours. During the think-aloud sessions, the subjects were interrupted several times by the interviewer and asked debriefing questions as well. Their "think-aloud protocols" were recorded and transcribed to provide a record of what subjects were thinking as they filled out the survey. The method and procedure for eliciting verbal protocols was adapted from Ericsson and Simon (1984). Verbal protocol techniques allow the collection of individual data without contamination from other subjects (as could occur, for example, when pretesting a survey using a focus group) while minimizing experimenter demand effects (as might occur in a question-and-answer session with an experimenter) and self-presentation and memory bias effects (as might occur when asking subjects to provide self-reports of what they were thinking after the fact).

Our main purpose in collecting the verbal protocols was to aid in redesigning the surveys before proceeding with larger-scale pretesting. The verbal reports identified several places in the survey that were unclear or were not being interpreted by subjects as intended by the researcher, allowing the survey design team a chance to correct such problems before the November and December pretests. For example, several subjects stated in their verbal reports that they were rejecting a No Cleanup option for natural resources because they thought it was an unacceptable alternative; in later versions of the survey the team changed the description of the No Cleanup option to Alternative Options, which reduced the amount of scenario rejection. Another problem was confusion with wording. For example, some people were unaware of the meaning of words such as tailings pile, trace metals, and leach pads. These words and others were identified and, where possible, either defined or removed from the survey.

A second purpose for collecting the verbal protocols was to help gain insight into the processes people use to interpret survey information and to arrive at contingent values. For example, it was clear from the verbal protocols of several subjects that their zero bids were not true zero values, but instead represented scenario rejection, i.e., dissatisfaction with some particular aspect of the scenario being valued (particularly the partial cleanup scenario). Sample text from the verbal protocols and debriefing responses obtained from these subjects, arranged by conceptual categories, are presented in Table B-1.

Table B-1
Sample Statements from the Verbal Protocols

Whose Responsibility?

I don't feel responsible, but I would like it to be cleaned up. I don't know — it's a hard one to think about. I would like it to be cleaned up, but I don't think it's my responsibility. The government should do it or the people who originally created it, but after so many years you can't do that. I don't feel like I should be responsible.

I think that, in general, I'm closer to the extremely responsible; but I wouldn't say that I'm ultimately responsible. But in terms of financial support I think that if Montana residents want to have their environment maintained, we have to be responsible.

Percentage Splits

I think most of the reason is for my family and myself; 60%. And 20% for future generations, and 20% if no one used them.

I don't have any idea how to answer that question because I have no idea what the biggest need is.

I think you have to have them all about the same otherwise you don't get the job done, so I guess that's 33 1/3.

Comments on General Information

"No Restoration of Surface Water." Well, without even reading it, I can tell you I wouldn't be satisfied at all. There are some things that can always be done, even if they're not real extreme.

"Pulling it back 3 feet from the water's edge": Stupid idea.

"44 million acre-feet of groundwater..." Whoa. Was it 1 acre-foot supplies a family of four? Four households, and they're talking about 44 million acre-feet. That's amazing!

I understood all of it. Figures really helped especially with how many acre-feet were contaminated — it's just an incredible amount. It's just scary.

Table B-1 (cont.)
Sample Statements from the Verbal Protocols

Valuation

If the method was more tax on fishing and hunting licenses, I think $3 would add up to be a lot.

If the tax would be on all state hunting and fishing licenses I think #2 since it would go for the whole state.

Well, I think that if they would assure me as a Montana resident that my money would ONLY go to the cleanup of the Clark Fork Site, and that somehow we could manage to keep the bureaucrats away from the money, so that they don't hire their own assistants for their assistants, I would say that I wouldn't mind an increase in my state or property or gasoline tax, or tax on hunting licenses or fishing licenses (since I don't buy either one of those!)
Increase my water bill? Nah.
Increase waste disposal? Nah.
A toll on highway I-90, that's an interesting idea. I'm afraid that somehow they would manage to have to hire a hundred people to do that; and we'd have to pay a hundred people a salary. If they could do it without having to hire a hundred people. I don't know if they could do that. It would be fine though. I can't imagine they could do that. But I'd pay a toll on I-90. The truckers would hate that.

What I'd be willing to pay and what I can pay are two different things. I'd like to see everything cleaned up, but at the same time, I don't make a whole lot, so I can't pay a whole lot.

I'm going to take into consideration what I can afford to pay. I'm a widow on a limited income. So that's going to make a difference for what I'm going to put down.

Why Zero Bid?

I don't know that I'd want any money to go to partial cleanup. It sounds like money wastage. It sounds like we'd be giving our money away to something that wasn't ultimately going to be beneficial. It's only going to be like sticking your finger in the hole in the dam. I guess I'd say I don't want to give any money to that. 0%.

I don't know, that partial restoration plan wasn't much. Isn't that the one where they really didn't say what they were going to do? Talking about hotspots and all of that. I'd say none if there can't be more.

B.2 SELF-ADMINISTERED SURVEY PRETEST I

Survey Pretest I included two survey versions described below, and was administered to 80 subjects in November 1992 in Helena and Missoula. Thirty-eight subjects completed Version 1, and forty-two subjects completed Version 2. The surveys were administered to six groups, three in Helena and three in Missoula, with an average number of approximately 14 subjects in each group. The groups were recruited in an identical manner and did not differ substantially in terms of age, gender, or income. The surveys were administered in person, not by mail or phone, so that any questions or problems with the purposefully long and complicated pretest instruments could be identified and answered. In these interviews respondents completed the survey alone (as if they had received it at home) with the exception they were told to note any problems or confusions. Then, respondents completed a formal debriefing interview, discussed the survey with the survey team, and were paid a $30 cooperation fee for their efforts. Typically, these sessions lasted about two hours.

Subject recruitment for the pretest studies was done by a marketing research firm experienced in recruiting people for studies on public issues. All subjects participating in the pretest sessions were Montana residents from either Helena or Missoula. No demographic restrictions were placed on subject eligibility, although telephone recruiters were instructed to obtain a mix on such factors as gender, age, and income. Both afternoon and evening sessions were provided to help ensure recruitment of a diverse sample. Care was taken to ensure that subjects and their household members were not currently employed by a marketing research firm or any environmental, governmental, or legislative group. In addition, any subjects who had ever participated in a public issues session on a related topic or had participated in a public issues session on any topic within the past three months were disqualified. At the time of recruitment, subjects were simply told they were being recruited to participate in "a very special type of study in which we are inviting selected individuals like yourself to participate in a group session that will focus on environmental issues for a research group." Subjects therefore did not know that the issue was cleanup of hazardous substances at the Clark Fork River Basin until the time of survey administration. On average, 10 phone calls were necessary to recruit one subject; 25 subjects were recruited for each of four administrations (2 survey versions at two sites) to obtain the final samples of 38 and 42 subjects for Pretest I Survey Versions 1 and 2, respectively.

Two pretest instruments were developed to investigate differences in wordings and differences in the structure of the presentation. Version 1 is most similar to the final survey in that general scientific information is presented along with two levels of cleanup actions and an acquisition option, and WTP is elicited for complete cleanup and partial cleanup. Version 2 presents a more limited general introduction that does not discuss the three options. Rather, Version 2 describes just the specific actions USEPA may require industry to take at the Clark Fork sites and elicits WTP to undertake additional efforts to obtain complete cleanup. In essence, Version 2 directly estimates residual damages. Next, Version 2 elicits WTP for replacement and acquisition response actions rather than actions to restore completely the

resources. In summary, an important difference is that in Version 1 all substitute response actions are introduced prior to the WTP questions, whereas this is not the case in Version 2.

Contingent values in all of the pretests and final versions are elicited as an annual payment for 10 years for cleanup of the Clark Fork NPL sites in Montana. Descriptive statistics for unadjusted willingness to pay for Pretest I are presented in Table B-2. (Three Version 1 respondents and two Version 2 respondents answered "don't know" to the WTP question.) Figures B-1 and B-2 present frequency distributions of WTP values for the November pretests. The distributions are plotted on log-dollar scales to normalize the distributions. Figure B-1 depicts the values for complete cleanup for Version 1. Figure B-2 shows the values for residual cleanup for Version 2. These data are not cleaned to remove likely protest zero bids or suspect high bids.

Table B-2
WTP Statistics — Survey Pretest I*

	Version 1 (complete cleanup)	Version 2 (residual damages)
Number of observations	35	40
Median	$125	$60
Minimum	$0	$0
Standard deviation of WTP	216.29	458.92

* Without data cleaning and unadjusted for embedding. Annual WTP for 10 years.

In Version 1, bids range between $0 and $1,000. The mean is $176.21 for 35 observations. The standard error of the mean is 36.56. Bids range between $0 and $2,250 in Version 2. The mean is $252.00 for 40 observations. The standard error of the mean is 72.56, which is much larger than the standard error for Version 1. The mean value may be misleading due to large outlier bids and small samples. In fact, both the median and lognormal error corrected mean are less for Version 2 than for Version 1 (see Section 5.3 for additional discussion of the lognormal error model). The difference in the distributions of values between Versions 1 and 2 may reflect the differences in the cleanup valuation scenarios and the absence of information regarding all three types of response options prior to the first WTP question in Version 2.

Figure B-1
Pretest I - WTP for Complete Cleanup - Version 1

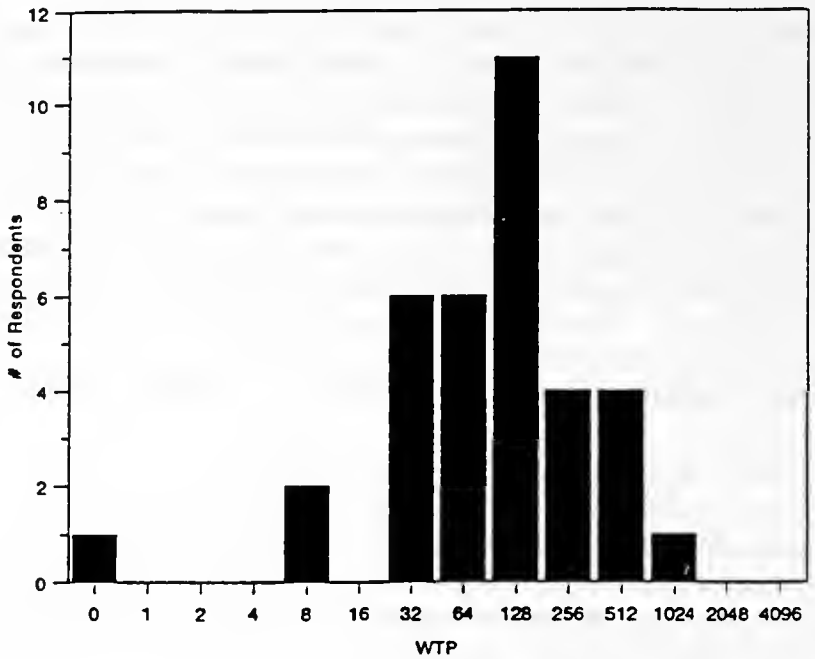
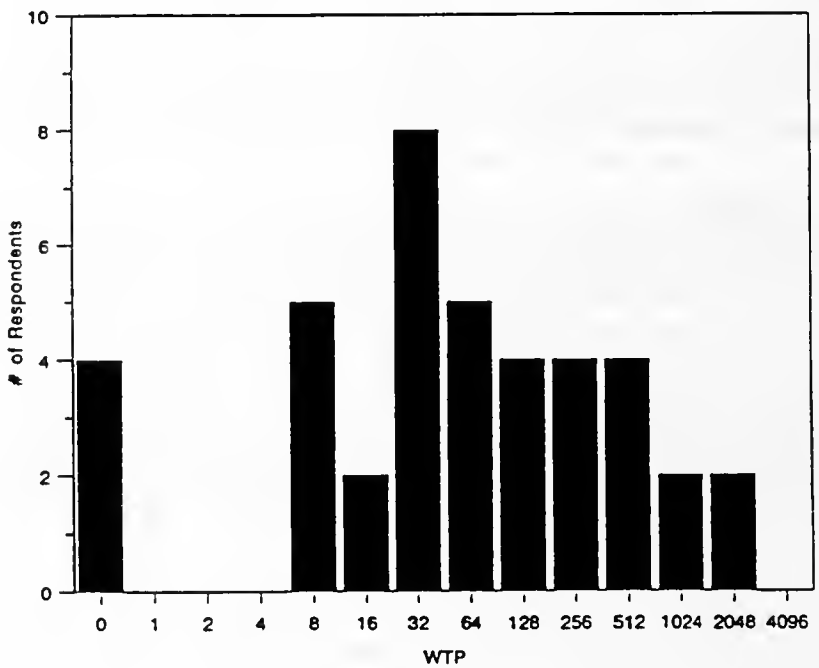


Figure B-2
Pretest I - WTP for Residual Cleanup - Version 2



After the survey, subjects were asked to answer a debriefing questionnaire (Appendix C) about what parts of the survey or items of information had any effect on them when deciding their values for complete cleanup (Version 1) or residual cleanup (Version 2). We present here a summary of results for both versions. Although these results are based on post-valuation self-reports, they provide useful insight into what specific types of information and context may prove to have substantive impacts on values as well as the direction of such effects.

Tables C-1 and C-2 in Appendix C summarize the self-reports of context effects from the November 1992 pretest, showing the percentage of subjects who indicated that information or questions in the survey had no effect on their valuation, caused them to lower their values, or caused them to raise their values for each of the specific categories of information and context. The most striking element of these results is that in Version 1, the "no effect" category dominates for almost all types of information. There are many reasons to expect context makes no difference in the evaluations of many people. First, some people's values may be already well-formed, or "crystallized," and therefore resistant to new information. Second, some subjects are likely using very simplified heuristics to arrive at WTP values that are independent of (or allow them to ignore) much of the detailed information (e.g., spending as much as they feel they can afford). Third, some of the information may be something many people already know. Fourth, some subjects may not pay attention to some information because they do not believe it or they dislike its implications (e.g., people may overlook or ignore the information given about alternative options because they dislike the implications of "no cleanup"). Finally, some of the information that experts and survey designers feel should be important may be seen by laypeople as unimportant or irrelevant. In Version 2, where there was less information, the information provided was associated with "no impact" or increasing values. Again the information was judged to be useful.

Certain categories of information and context do appear to have very reliable directional effects. Providing information on the four NPL sites in Montana that are not in the Clark Fork River Basin, for example, caused 33 percent of respondents to raise their values, and none to lower values in Version 2. Also, the information about alternative response options to contamination of different resources in Version 1 (for example, removing contamination from groundwater by public treatment plants, or piping in water from other sources) caused many people to lower their values, although a substantial, but smaller, number raised their values instead. The effect of these alternative options may generally make people lower their values because they realize less expensive alternatives are available. However, a few may raise their values after reading about these options because the options make more salient certain benefits they would get with complete cleanup that they had not previously considered.

Lastly, at least 86 percent of all the respondents found the figures, photos, and maps to be informative for the valuation question. The results indicate that subjects were using most of the information in the survey, and therefore, most of it should be retained in later versions.

B.3 SELF-ADMINISTERED SURVEY PRETEST II

Three versions of Survey Pretest II were administered to a total of 112 subjects. The subjects were recruited according to the procedures used for Survey Pretest I (see Section B.2 for details). Six groups of subjects completed three versions of the survey on December 14th and 15th in Helena and Missoula. Respondents were paid $20 for approximately one hour of time. Survey Version 1 asks respondents to give a value for complete cleanup of hazardous substances and then to derive a value for partial cleanup (much like the final Version 1). Survey Version 2 differs from Version 1 only by asking respondents to give a value for partial cleanup first, and then derive a value for complete cleanup (much like the final Version 2). Survey Version 3 is a "reduced-context" version that removes all general information regarding the contamination of natural resources and cleanup options, and removes descriptions of the four Montana NPL sites that are not in the Clark Fork River Basin. Specific information about the injuries and cleanup at the Clark Fork sites is still discussed.

Table B-3 summarizes the ADJWTP descriptive statistics for all versions of Pretest II. In Version 1, the mean ADJWTP for complete cleanup was $125.45 for 31 observations. There were 39 subjects who filled out Version 1, but eight respondents were omitted due to inconsistent information, "don't know" responses, etc. Bids range between $2 and $1,125. The mean ADJWTP for partial cleanup was $88. In Version 2, for which respondents were asked to value the partial cleanup scenario first, the mean ADJWTP bid for partial cleanup was $96.95. Bids range between $2.50 and $1,050 for 31 observations. From an initial sample of 37, 6 responses were excluded from the analysis; 4 people answered "don't know," 1 was missing WTP, and 1 was an extreme WTP value. The mean value for complete cleanup, $124.44, is very similar to the value in Version 1 ($125.35). The results were encouraging regarding consistency for the commodity being valued. That is, subjects seem to have different values for the complete cleanup scenario versus the partial cleanup scenario, in spite of the order in which they are asked to value them. The mean ADJWTP for complete cleanup in Version 3, the reduced information context version, is $100.74. This result is consistent with the information obtained from the debriefing questions in that subjects said much of the information they received raised their values. The more they understood the issues, the more they valued undertaking the response actions. The mean ADJWTP value for partial cleanup in Version 3 is $79.90. The initial sample size was 36, but 5 people responded "don't know," bringing the final count to 31.

Frequency distributions of complete and partial ADJWTP values for all three versions of Pretest II are reported in Figures B-3a, B-3b, B-4a, B-4b, B-5a, and B-5b. For Versions 1 and 2, the variances for partial and complete cleanup are virtually the same, but the distributions are shifted to lower values for partial cleanup. The values in Version 3 are lower than for Versions 1 and 2, and the frequency distributions for complete cleanup for Versions 2 and 3 are nearly symmetric (Figures B-4a and B-5a).

Table B-3
ADJWTP Statistics — Survey Pretest II

Version	Partial Cleanup			Complete Cleanup		
	1	2	3	1	2	3
Description	Complete Cleanup WTP First	Partial Cleanup WTP First	Reduced -Context Version	Complete Cleanup WTP First	Partial Cleanup WTP First	Reduced-Context Version
Mean ADJWTP* after cleaning (std. error of mean)	$88.00 (36.71)	$96.95 (32.93)	$79.90 (30.62)	$125.45 (36.65)	$124.44 (34.80)	$100.74 (30.47)

* Annual ADJWTP for 10 years.

Figure B-3a
Pretest 2 - ADJWTP for Complete Cleanup - Version 1

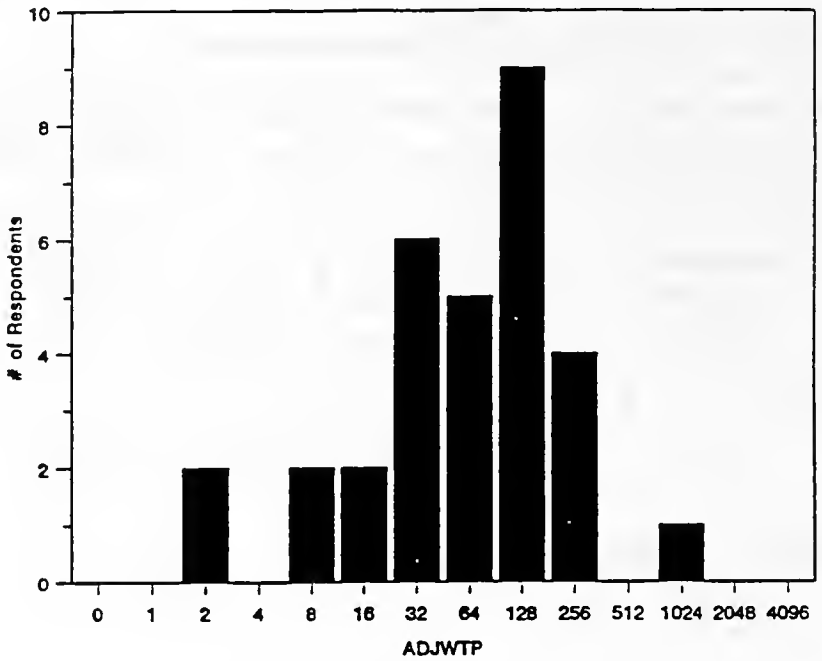


Figure B-3b
Pretest 2- ADJWTP for Partial Cleanup - Version 1

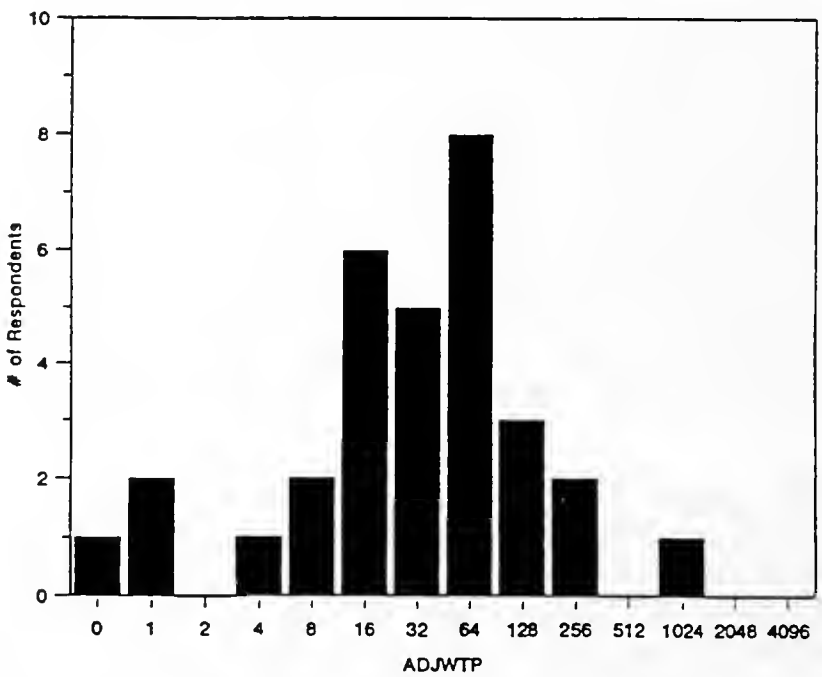


Figure B-4a
Pretest 2 - ADJWTP for Complete Cleanup - Version 2

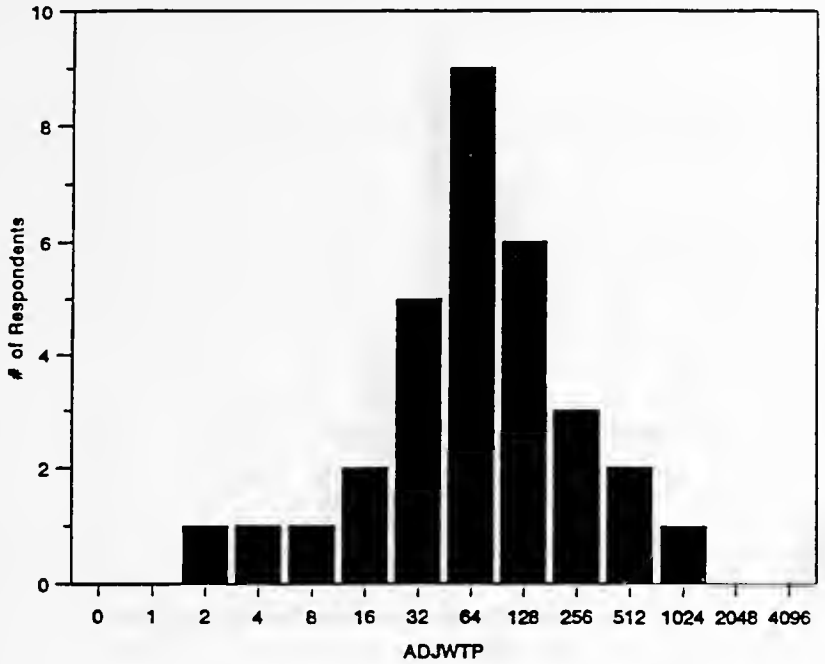


Figure B-4b
Pretest 2 - ADJWTP for Partial Cleanup - Version 2

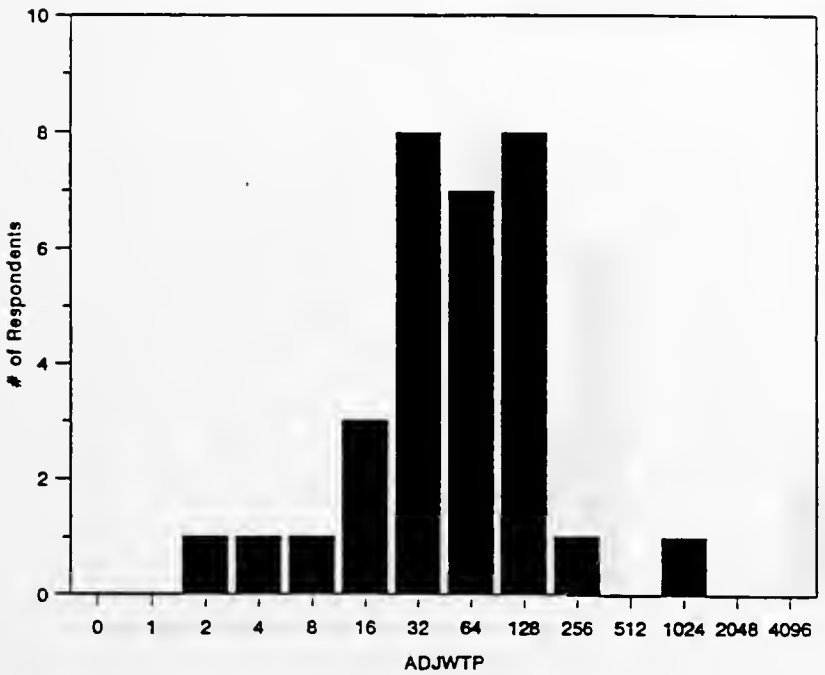


Figure B-5a
Pretest 2- ADJWTP for Complete Cleanup - Version 3

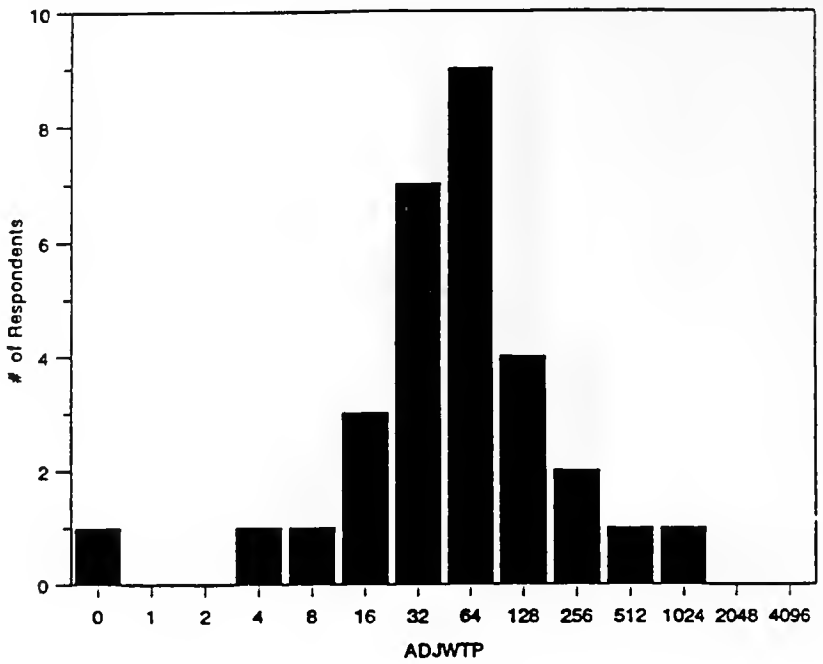
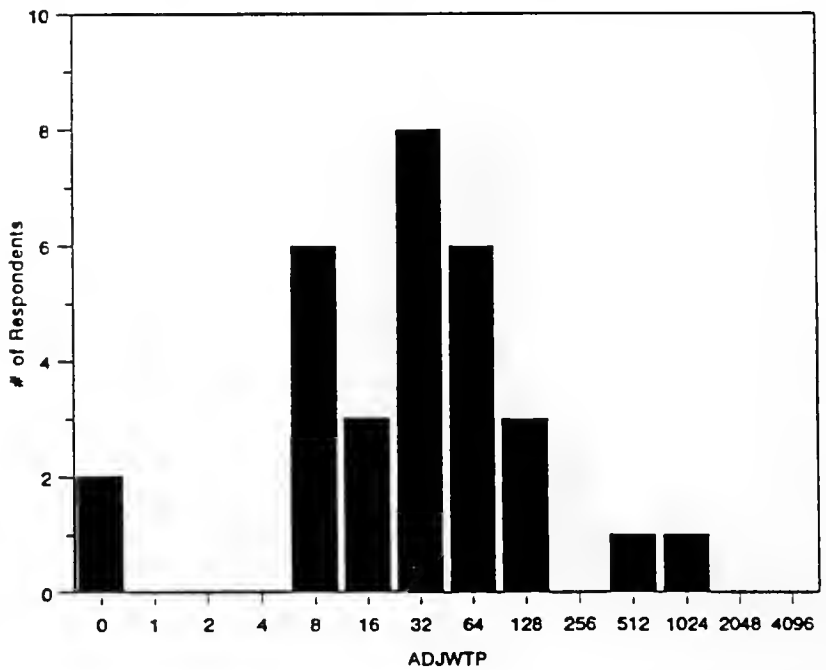


Figure B-5b
Pretest 2 - ADJWTP for Partial Cleanup - Version 3



APPENDIX C
DEBRIEFING

- **Debriefing Questionnaire**
- **Debriefing Results**

After-survey Questions

Thank you for completing our survey. We would like to understand your answers better and to make sure that the survey made sense to you.

Please read along with the survey as you complete this sheet. You will be asked questions about the survey, in order.

Were there any parts in this survey that you found confusing? Please circle any confusing parts with your red pencil and tell us why the parts were confusing in the space below.

Did you understand the questions in this survey? If so, which ones? Please circle any questions that you didn't understand with your red pencil.

Are there any issues or concerns that you think should be added to this survey? If so, please note them in the space below.

Q35 asked for your value to fund efforts to achieve complete restoration of natural resources at the Clark Fork NPL Sites. When thinking about your value for complete restoration of these natural resources, some information may have been more relevant than other information. Certain items may have caused you to think, "Oh, my value was too high, I have to lower it to take this into account." Or some items may have caused you to think "Oh, my value was too low, I have to raise it to take this into account." We are now going to ask you to look back to some of the specific questions you have answered and tell us whether or not you took this information into account when determining your value for complete restoration of the natural resources at the Clark Fork NPL sites.

On page 2, you are given information about surface water contamination. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q7 describes complete cleanup of surface water. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q8 describes partial cleanup of surface water. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q9 describes alternative options that may be taken to clean up surface water. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 5, you are given information about groundwater contamination. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q12 describes complete cleanup of groundwater. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q13 describes partial cleanup of groundwater. Did this information affect your value ?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q14 describes alternative options that may be undertaken to clean up groundwater. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On pages 7 & 9, you are given information about air, soil, vegetation and wildlife contamination. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q17 describes complete cleanup of soil. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q18 describes partial cleanup of soil. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q19 describes alternative options that may be undertaken to clean up soil. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q20-Q23 describe four of Montana's NPL sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q24-Q30 describe the Clark Fork NPL sites. Did this information affect your values (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 15, you are given information about surface water contamination at the Clark Fork sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 17, you are given information about air, soil, vegetation and wildlife contamination at these sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 18, you are given information about groundwater contamination at these sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

In Q40 you stated how much you would be willing to pay to achieve complete cleanup. Q47 describes alternatives that might be undertaken if complete cleanup were not possible. You were asked to state what percent of the total amount you would pay for partial cleanup. How did you arrive at your answer in Q47?

Did you find the maps included in this survey to be informative?

Did you find the photos to be informative?

Did you find the figures included in this survey to be informative?

Please use the space below for any additional comments that you would like to add.

After-survey Questions

Thank you for completing our survey. We would like to understand your answers better and to make sure that the survey made sense to you.

Please read along with the survey as you complete this sheet. You will be asked questions about the survey, in order.

Were there any parts in this survey that you found confusing? Please circle any confusing parts with your red pencil and tell us why in the space below.

Did you understand the questions in this survey? If not, which ones? Please circle any questions that you didn't understand with your red pencil.

Are there any issues or concerns that you think should be added to this survey? If so, please note them in the space below.

Q30 asked for your value to fund efforts to achieve complete restoration of natural resources at the Clark Fork NPL Sites. When thinking about your value for complete restoration of these natural resources, some information may have been more relevant than other information. Certain items may have caused you to think, "Oh, my value was too high, I have to lower it to take this into account." Or some items may have caused you to think "Oh, my value was too low, I have to raise it to take this into account." We are now going to ask you to look back to some of the specific questions you have answered and tell us whether or not you took this information into account when determining your value for complete restoration of the natural resources at the Clark Fork NPL sites.

On pages 2 & 4, you are given information about contamination of surface water, groundwater, and vegetation and wildlife. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q8-Q11 describe four of Montana's NPL sites. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q12-Q15 describe the Clark Fork NPL sites. Did this information affect your value (please circle)?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 9, you are given information about surface water contamination at these sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 11, you are given information about vegetation and wildlife contamination at these sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On page 12, you are given information about groundwater contamination at these sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

On pages 13 & 14, you are given information about the planned cleanup actions for each type of contamination at the Clark Fork Sites. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

Q27 describes additional actions that could be undertaken to provide complete cleanup of natural resources. Did this information affect your value?

Lowered value **Didn't affect value** **Raised value**

1_____2_____3_____4_____5_____6_____7

In Q30 you stated how much you would be willing to pay to achieve complete restoration. Q34 describes alternatives that might be undertaken if complete restoration were not possible. In Q35 you stated what percent of the total amount you would pay if complete restoration was not feasible but partial restoration was. How did you arrive at your answer in Q35?

Did you find the maps included in this survey to be informative?

Did you find the photos to be informative?

Did you find the figures included in this survey to be informative?

Please use the space below for any additional comments that you would like to add.

Table C-1
Self-Reported Effects of Context — November 1992 Pretest
Version 1

Information Given	No Effect	Lowered Value	Raised Value
Surface water			
Contamination	58%	0%	42%
Complete cleanup	55%	5%	40%
Partial cleanup	66%	26%	8%
Alternative cleanup	53%	29%	18%
Groundwater			
Contamination	71%	0%	29%
Complete cleanup	74%	16%	10%
Partial cleanup	53%	29%	18%
Alternative cleanup	29%	45%	26%
Air, soil, vegetation, and wildlife			
Contamination	55%	8%	37%
Complete soil cleanup	55%	3%	42%
Partial soil cleanup	66%	16%	18%
Alternative soil cleanup	29%	53%	18%
Four Montana NPL sites			
Description of sites	50%	3%	47%
Clark Fork NPL sites			
Description of sites	47%	0%	53%
Surface water contamination	39%	3%	58%
Soil contamination	42%	3%	55%
Groundwater contamination	39%	11%	50%
		Informative	**Not Informative**
Maps		92%	8%
Photos		86%	14%
Figures		97%	3%

Table C-2
Self-Reported Effects of Context — November 1992 Pretest
Version 2

Information Given	No Effect	Lowered Value	Raised Value
Surface water, groundwater, soil, vegetation, and wildlife contamination	60%	0%	40%
Description of four Montana NPL sites	67%	0%	33%
Clark Fork NPL sites			
Description of sites	55%	0%	45%
Surface water contamination	50%	0%	50%
Soil, vegetation, and wildlife contamination	52%	7%	41%
Groundwater contamination	52%	7%	41%
Planned cleanup actions	50%	15%	35%
Complete cleanup	33%	29%	38%
		Informative	**Not Informative**
Maps		93%	7%
Photos		88%	12%
Figures		88%	12%

APPENDIX D
DR. DONALD DILLMAN'S RESPONSE TO THE JANUARY 11, 1993 NOAA "PANEL ON CONTINGENT VALUATION" REPORT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
POLICY, PLANNING AND EVALUATION

April 2, 1993

Professor V. Kerry Smith
Department of Economics and Business
North Carolina State University
Box 8110
Raleigh, NC 27695

Dear Kerry:

I have just received the enclosed response from Dr. Don Dillman, Chief Scientist of the U.S. Census Bureau, Director of the Social and Economic Sciences Research Center at Washington State University, and a noted expert on survey methods, to a request that I made of him on February 12 to review those portions of the "Nobel Panel" report of January 1993 that relates to survey methods. Although his response is not on behalf of the Census Bureau, his comments nevertheless take on added significance in light of his position there.

I find his response of considerable interest and believe that it is relevant to the review by your SAB Committee of the Colorado report.

Sincerely yours,

Alan Carlin
(PM-221)

cc: C. Jones (NOAA)
A. McGartland
W. Schulze
S. Rondberg

Washington State University

March 31, 1993

Mr. Alan Carlin
Office of Policy, Planning and Evaluation
United States Environmental Protection Agency
Washington D.C. 20460

Dear Mr. Carlin:

In your letter of February 12, 1993, you asked by opinion about the recommendation against the use of mail surveys and support of much costlier techniques such as in-person interviews, by the NOAA panel of Nobel laureates in economics and others.

I have read the relevant sections of their report, especially pp.30 and 46-48, and the sections headed "Personal Interview." I'm sympathetic to several of the points the panel raised about the inadequacies of mail surveys, but also believe that they have glossed over, and even ignored some of the difficulties with personal interview and telephone surveys.

One of the panel's objections to mail surveys is the sample frame problem, and this concern is in some cases legitimate. In general there are no readily available household lists for conducting national mail surveys, so that non coverage is a major source of error. The problem is not as bad as they have implied however. They assume the most general case of all adults in the U.S. an urban area, or a state, and then suggest that half the U.S. Population will not be in telephone directories. I don't know from where they obtained that number, but it is higher than ones I have seen, except for southern California. Their assumption of a 75 percent response rate from the remainder is reasonable. They overlook that voter registration lists and drivers license lists are available from many states. It is also the case that contingent evaluation surveys are sometimes done using lists that are quite adequate, e.g. people with hunting or fishing licenses.

Secondly, the report concludes that mail questionnaires will elicit biased answers because of appealing only to those most interested in a natural resource issue, or on one side or the other of the issue. This problem can be dealt with to some degree by obtaining high response rates and through careful questionnaire design. The panel does not recognize that such topical appeal can be a problem with telephone and face-to-face interviews. In fact it is a problem with these methods, especially now that so much more non response to telephone

happens during the course of the interview rather than just being concentrated at the beginning of the interview.

Third the report indicates that it is impossible to guarantee random selection within households or to confine answering to a single respondent, and that it is difficult to control question order effects. This issue is fairly complicated and there is a real lack of data on this concern. It is also impossible to guarantee random selection by the other methods, and when it is close to being achieved it is often off-set in part by lower response rates, because of the very threatening, "How many people live in the household, how many are females (or males), how old are they, etc" sequence that must precede any interviewing. In mail surveys the more common method is to ask for the person with the most recent birthday, and it's unclear how much bias is associated with its use in such surveys. I should also note that for registered voter and other lists, the respondent selection issue they raise is irrelevant.

Whether only one person answers a mail questionnaire is something we really don't know; a definitive study on that topic simply hasn't been done. However, personal interviewing is not immune to that concern. Interviewers are usually trained to avoid such influences, but I've seen instances in which it is impossible to keep a second person from answering the questions addressed towards the interviewee. More typically, the other person sits there and the interviewer never knows the extent to which a respondent takes that other person into account with their answers.

I was rather disappointed that the report didn't raise the issue of social desirability bias, the tendency to offer answers that are normative or that the respondent thinks the interviewer wants to hear. There is considerable evidence that more such bias exists in telephone and face-to-face interviews than in self-administered surveys. In some of the contingent evaluation surveys I have been asked to comment on, it seemed likely that respondents would give socially desirable answers. Also, there is some evidence that interviewed respondents give more extreme answers to telephone and face-to-face interviews, which when combined with social desirability tendencies may result in substantial bias from the use of interview methods. The report should have recognized these potential problems with interview surveys.

The concern about people most interested in a natural resource issue or who are on one side or the other being more likely to respond to mail surveys is an often stated criticism, but a hard one on which to provide data. If one uses all the available procedures for obtaining a high response rate to mail surveys, I question whether that will be much more of a problem than in the

telephone survey, which is now so easy for reluctant respondents to terminate.

The issue about question order effects is a curious one. The existing published literature suggests that order effects are less of a problem in mail surveys than in interview surveys of either type (although I believe this issue to be far from settled). In any event it's curious how one of the desirable qualities of mail surveys gets turned into a negative feature here.

The recommendation that mail surveys be used only if another supplementary method can be employed to cross-validate the results on a random sub-sample of respondents," is a reasonable one, and could be argued for the other methods as well. The social desirability and extremeness biases that may occur in interview surveys, and seem less likely to occur in mail surveys, argue for the cross-validating of interview surveys.

In summary, there are legitimate reasons for being cautious about the use of mail surveys. However, I don't really think the panel's assessment is either balanced or objective. It should also have dealt with the virtual impossibility of guaranteeing high response rates to face-to-face surveys without paying extremely high costs, and it should have dealt with the noncoverage problems of getting into certain areas of the cities, where prudent interviewers will likely refuse to go, or simply can't get in because of gatekeepers (e.g. a condominium complex). It should also have dealt with the possibilities of social desirability and extremeness biases. Finally, it should also have dealt with the reality of today's industry standards for face-to-face and telephone interviewing. Frankly, I worry that a report like this will be used to "legitimate" these methods, and then the actual response rates will be quite low because of the limited resources for doing the studies. It's also likely that important contingent evaluation studies simply won't get done, because they will no longer be practical.

I could imagine a report like this being done at some historical time to argue that a legitimate U.S. Census couldn't be done by mail. (Mail is now relied on for the doing most of the data collection, and has far fewer item non response and perceived measurement problems than does the portion of the census collected by enumerators). I could imagine such a report being used to keep the Current Population Survey which is used to establish unemployment rates, from being done in part by telephone. Had we not learned to use these alternative methods, costs would likely have forced us to do a greatly abbreviated Census and establish unemployment rates less frequently than monthly, as is now done. Why try to hold contingent evaluation surveys to "standards" to which these two far more important national surveys cannot be held?

It's my conclusion that the report does exhibit considerable bias against mail surveys. Some of the attributed defects are real, but others are not. More importantly, the report tends to gloss over measurement issues and the problems of producing valid face-to-face surveys results. It assumes the sky-is-the-limit on costs. If the nation needs for contingent valuation surveys to be done, then surely there is a need for making the methodology practical, rather than specifying requirements that will make such surveys only available for those few national problems for which government and large corporations are willing to pay the excessive costs required for the questionable perfection that seems to be demanded by the report.

The direction I would recommend is to think more about mixed mode (more than one method) and "cross-validation" surveys like that mentioned on page 47. Also, I have long sensed that some government and major survey organizations have been reluctant to do quality mail survey work, perhaps for reasons similar to why U.S. automobile manufacturers avoided building smaller cars; they are comfortable with face-to-face interviews, and to some extent telephone, because that's what they know how to do. One way of reducing mail survey costs is to build sample frames while doing interviewing for other purposes, but I sense that it's not something considered very profitable for large survey firms to do, and so far not much effort along these lines has been undertaken.

I hope these comments are helpful.

Cordially,

Don A. Dillman
Professor and Director

APPENDIX E
PREFERENCE FOR WITHIN-SAMPLE DIFFERENCES FOR COMPUTING RESIDUAL DAMAGES

In this appendix the methods in Keren (1993) are used to demonstrate that within-sample differences provide more accurate residual damage estimates than do between-sample differences.

Let WTP_{Pi} represent the amount that the i-th individual is willing to pay for partial cleanup.

We can model this as:

$$WTP_{Pi} = \mu + \alpha_i + \epsilon_{Pi} \quad \text{(E-1)}$$

where μ is the true population mean for partial cleanup, α_i is true amount that the i-th individual deviates from the mean (i.e., $\Sigma\ \alpha_i = 0$), and ϵ_{Pi} represents errors of measurement. Similarly, the amount that the i-th individual is willing to pay for complete cleanup is modeled as:

$$WTP_{Ci} = \mu + \alpha_i + \beta + \gamma_i + \epsilon_{Ci} \quad \text{(E-2)}$$

where β represents the increment, if any, for the value of complete cleanup over partial cleanup, and γ_i represents the individual variation in this value as a deviation around β (i.e., $\Sigma\gamma_i = 0$).

There are two ways to estimate the value difference between partial and complete cleanup. The first is "within-respondent" where WTP is obtained for both options from each respondent. Then, an estimate of the difference is calculated as:

$$\begin{aligned} D_i = WTP_{Ci} - WTP_{Pi} &= (\mu - \mu) + (\alpha_i - \alpha_i) + \beta + \gamma_i + (\epsilon_{Ci} - \epsilon_{Pi}) \\ &= \beta + \gamma_i + (\epsilon_{Ci} - \epsilon_{Pi}) \end{aligned} \quad \text{(E-3)}$$

for each individual. The expected value of the average is:

$$\bar{D} = \beta \quad \text{(E-4)}$$

and the expected variance of this mean is given by:

$$\sigma^2_{Wthn} = (\sigma^2_\gamma + \sigma^2_{\epsilon c} + \sigma^2_{\epsilon p}) / n \qquad \text{(E-5)}$$

where n is the number of respondents.

The second way to estimate the value difference is "between-respondent" where WTP is obtained for complete cleanup from one group of n respondents, and for partial cleanup from a separate group of n respondents. Then,

$$\begin{aligned} D_i = WTP_{Ci} - WTP_{Pi'} &= (\mu - \mu) + (\alpha_i - \alpha_{i'}) + \beta + \gamma_i + (\epsilon_{Ci} - \epsilon_{Pi'}) \\ &= \beta + \gamma_i + (\alpha_i - \alpha_{i'}) + (\epsilon_{Ci} - \epsilon_{Pi'}) \end{aligned} \qquad \text{(E-6)}$$

where i and i' represent respondents from the different groups or samples. Again, we have:

$$\bar{D} = \beta \qquad \text{(E-7)}$$

but now the expected variance of this mean is:

$$\sigma^2_{Btwn} = (2\sigma^2_\alpha + \sigma^2_\gamma + \sigma^2_{\epsilon c} + \sigma^2_{\epsilon p}) / n \qquad \text{(E-8)}$$

It is then easy to compare the expected variances, and hence the expected precision, of the two estimates by subtracting to get:

$$\sigma^2_{Btwn} - \sigma^2_{Wthn} = 2\sigma^2_\alpha / n \qquad \text{(E-9)}$$

This expression is necessarily always positive, so the between-respondent estimate will always have greater variance than the within-respondent estimate. In other words, the within-respondent estimate is necessarily more precise statistically, and the difference in precision is a function of the individual variability in values for partial cleanup. The greater the variability in those individual values, the greater the superiority of the precision of the within-respondent estimate. This result is consistent with the CVM results reported in Chapter 5.0.